VOL. XVIII, No. 2 AUGUST, 1949

THE TOOL ENGINEER

REG. U.S. TRADE MARK

OFFICIAL PUBLICATION: AMERICAN SOCIETY OF TOOL ENGINEERS

Understanding is a Basic Tool . . . . . By R. B. Douglas 1

Product Design and Its Relation to Milling Cutter and Machine Selection . . . . . By Mario Martellotti 17

Fundamentals of Compression Bending . . . . By Ralph M. Shaw, Jr. 21

Current Trends in Cutting Fluids . . . . . By James McElgin 23

How to Engineer and Coordinate Shop Training Programs . . . . . By Walter J. Brooking 25

The Function of Interchangeability in Tool Engineering . . . . . By G. H. Stimson 29

Design of Broaching Fixtures . . . . . By John A. Markstrum 32

Principles of Contour Turning and Boring . . . . . By Cecil Clark 36

Machining High Nickel Alloys . . . . . By Gilbert P. Muir 38

Precision Toolmaking via "Lost Wax" Casting . . . By A. E. Rylander 42

Tool Engineering Data 47

Departments

Andygrams, 59 ● ASTE News, 49 ● Gadgets, 44 ● North, East, West, South in Industry, 46 ● Tools of Today, 61 ● Trade Literature, 60 ● Index to Advertisers, 110

Behind every manufactured product is the tool engineer

All yours...

this "gold mine" of GAGING INFORMATION FROM Accuracy Headquarters

CATALOG NO. 11

contains the complete listing of P&W Gages and Gaging Equipment. To obtain a copy of Catalog, or of any individual Bulletin(s) illustrated, simply check the corresponding numbers in this coupon . . .

Pratt & Whitney

Division Niles-Bement-Pond Company

WEST HARTFORD 1, CONNECTICUT

Pratt & Whitney
16 Charter Oak Boulevard
West Hartford 1, Conn.

I'd like to have, without obligation, the P&W Gage literature checked below. Please send to

Name.....

Firm.....

Position.....

Address.....

City.....State.....

1....	4....	7....	10....	13....
2....	5....	8....	11....	14....
3....	6....	9....	12....	15....

Catalog No. 11....

The Tool Engineer

Official Publication: American Society of Tool Engineers

Robert B. Powers
Publisher
John S. Eacock
Circulation Manager
James Curran, Jr.
Production Manager
Robert Steiger
Art Director

Editorial

Gilbert P. Muir
Editor
A. E. Rylander
Technical Editor
Doris B. Pratt
A.S.T.E. News Editor

Advertising

Clarence T. Etter
Advertising Manager
James E. Hartnett
Western Manager, 540 N. Michigan Ave., Chicago, Ill.
Austin G. Cragg
Eastern Manager, 400 Madison Ave., New York, N. Y.
Henry & Simpson
Pacific Coast Representatives 816 W. 5th Street Los Angeles 13, Cal.

Editorial Committee

I. F. Holland, *Chairman;* L. B. Bellamy, R. E. Crawford, W. B. McClellan, W. F. Sherman

Officers

R. B. Douglas
President
H. L. Tigges
First Vice-President
J. J. Demuth
Second Vice-President
H. F. Owen
Third Vice-President
W. B. McClellan
Secretary
G. A. Goodwin
Treasurer
H. E. Conrad
Executive Secretary

Board of Directors

R. B. Douglas, *Chairman;* K. L. Bues, H. E. Collins, J. J. Demuth, T. J. Donovan, Jr., R. W. Ford, I. F. Holland, H. J. Richards, H. L. Tigges, G. S. Wilcox, Jr.

August, 1949

Vol. XXIII, No. 2

Understanding Is a Basic Tool

MAN'S INGENUITY TO create material things never ceases to be a marvel. Through science and the application of his vitality he has split the atom, harnessed rivers, subdued most of his natural enemies, conquered the land, sea and air, and has generally made his lot easier by the development of countless labor-saving devices.

Indeed this is a wonderful mechanism of flesh, blood, mind and soul. His tools and energy have brought wealth and beauty from barren soil. His intellect and physical faculties produce great music and symphonies from tools he has fashioned. His planes out perform birds in flight. He understands most of the mysteries of astronomy. He has explored the ills to which flesh is heir and can extract from a common mold agents powerful enough to combat the most frightful of human diseases.

Yet, with all of this knowledge, man does not understand himself. Neither does he understand his neighbor, his boss, his employees nor his enemies nor friends. All we have to do is to look about to know that we haven't begun in our struggle for knowledge to meet this vital need of understanding.

In this complex world of ours, it becomes increasingly important that we come to know our deficiencies and recognize our failures. We are struggling against time. If we want to preserve our enterprise system, for example, we must constantly push harder to achieve a better basic understanding of the conflicting tides of intellect and emotion that make up our society.

The threat of communism, collectivism and statism looms on the horizon as the most serious threats to our social, economic and spiritual well being. We must understand how these ideologies are bred and why some of our fellow men are taken in completely by them.

In looking at these highly publicized traps which have been set for our economy, we would be extremely short-sighted if we did not follow just as carefully the constant and sometimes mounting tensions that exist between labor and management. In many ways this struggle between factions within our own country, between our own citizens, constitute a greater danger than those of outside forces and those of statism and collectivism. Indeed, with the implementation of misunderstanding, one might bring on the other and we would find ourselves plagued both with industrial strife and an unjust and inefficient statism under the guise of government.

There is no simple solution of these problems. Most likely the answer lies in education for understanding, tolerance, and the application of common sense. Education must be devised for our schools and spread through the spoken and printed word into the highways and byways of life. This will bring tolerance. Common sense can be applied by all thinking individuals if they will remember what Addison, a great thinker, had to say on the subject:

"If men would consider not so much wherein they differ, as wherein they agree, there would be far less of uncharitableness and angry feeling in the world."

And so, let us, in our daily enterprises, reverse the common procedure and try to discover among our workers areas of agreement instead of rubbing the old sores of disagreement. Once the areas of agreement are established, those in which we are in disagreement become easier to solve or reconcile.

We, as tool engineers, can help in the development of some new and better tools for a clearer understanding between the workers and the managers, and in so doing, we will have contributed more to production and to economic stability than by devising better machines.

Understanding is a basic tool in human relations. It must become a basic tool in industry.

R. B. Douglas

President 1948-49

THE TOOL ENGINEER is published monthly in the interest of the members of the American Society of Tool Engineers. Entered as second class matter, November 4, 1947, at the post office at Milwaukee, Wisconsin, under the Act of March 3, 1879. Yearly subscription, $2.00. Non-members, $6.00. Canada, $6.50; all other foreign countries, $8.00 per year. Copyright 1949 by the American Society of Tool Engineers.
OFFICE OF PUBLICATION (printing) 239 E. Chicago St., Milwaukee, Wis. **ADDRESS ALL CORRESPONDENCE TO: EDITORIAL AND ADVERTISING OFFICES:** 550 W. Lafayette Blvd., Detroit 26, Mich. **NATIONAL HEADQUARTERS:** American Society of Tool Engineers, 10700 Puritan Ave., Detroit 21, Michigan.

You Win on Every Move!

Every product in this new catalog is KENNAMETAL, made to be a winner in productivity . . . in cost-saving

With Catalog 49 is a discount sheet announcing a 25% reduction in the price of standard brazed tools listed. Savings in production costs effected by improved manufacturing techniques enable us to give you this plus value.

Outstanding durability is inherent with Kennametal. Its structure is consistently sound, hardness is uniform, strength unusually high. All processing is done in our own plant, from the refining of raw materials to fabrication of complete tools. The methods and equipment used are original and exclusive. Every step is subjected to rigid laboratory control and physical inspection.

On metal-working tools the superior merits of Kennametal are manifest in longer life, reduced grinding expense, lower tool inventory, less machine down time, greater operator efficiency.

As parts of machines, particularly those subjected to wear, the noteworthy properties of Kennametal are evident in greater durability and better performance than ever realized with any other metal.

A new grade of Kennametal, developed to provide high resistance to oxidation at elevated temperatures, has many potential uses.

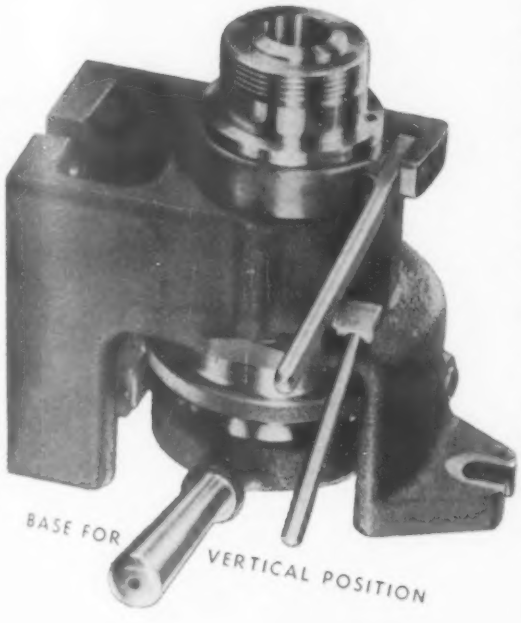
Our new Catalog 49 contains a wealth of information for metal-working plants. To secure your copy will be a good move. It suggests many subsequent moves that can be made to your advantage.

KENNAMETAL *Inc.*, Latrobe, Pa.

MANUFACTURERS OF SUPERIOR CEMENTED CARBIDES AND CUTTING TOOLS THAT INCREASE PRODUCTIVITY

HARDINGE HORIZONTAL - VERTICAL

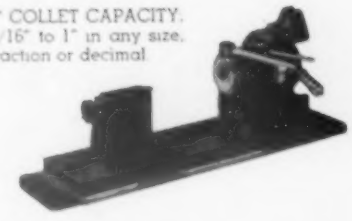
Collet Index Fixtures with Threaded Nose Spindle are fast in operation and hold work accurately



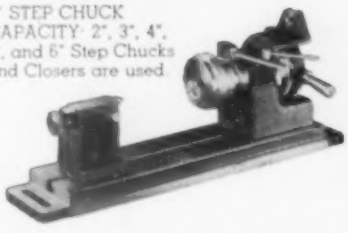
In addition to taking standard collets, this fixture takes step chucks and jaw chucks to cover a wide range of applications. It will eliminate the necessity of your tool room making many specially designed fixtures. Thus, your engineers and tool-makers will have more time for other work.

A preselector arrangement provides the selection of separate indexing of any number divisible into 20 or 24. The collet closer lever has a 100 to 1 leverage for quick opening and closing of collets and step chucks. Write for bulletin.

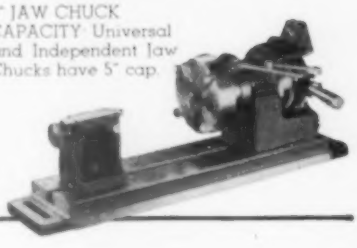
1" COLLET CAPACITY. 1/16" to 1" in any size, fraction or decimal.



6" STEP CHUCK CAPACITY. 2", 3", 4", 5", and 6" Step Chucks and Closers are used.



5" JAW CHUCK CAPACITY. Universal and Independent Jaw Chucks have 5" cap.



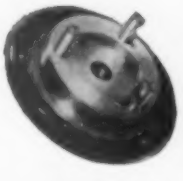
HARDINGE
ELMIRA, N.Y.

HARDINGE-SJOGREN SPEED COLLET CHUCKS

increase production of your lathes and milling machines

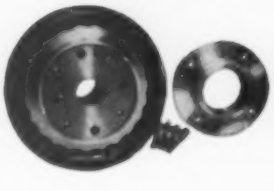
A Hardinge-Sjogren Nose Type Speed Collet Chuck enables you to get full value from your toolroom lathes, engine lathes and milling machines. It gives greater capacity, saves time, increases accuracy and assures better results. An almost effortless turn of the handwheel, one way or the other, automatically opens or closes the collet, releasing or gripping the work as desired. Its grip is adjustable and sure. Production is increased as the operator is always in front of his work. Available in these sizes . . . 1", 1⅜", 1¾", 2¼", or 3½" collet capacity. Write for bulletin.

For CAM-LOCK SPINDLES



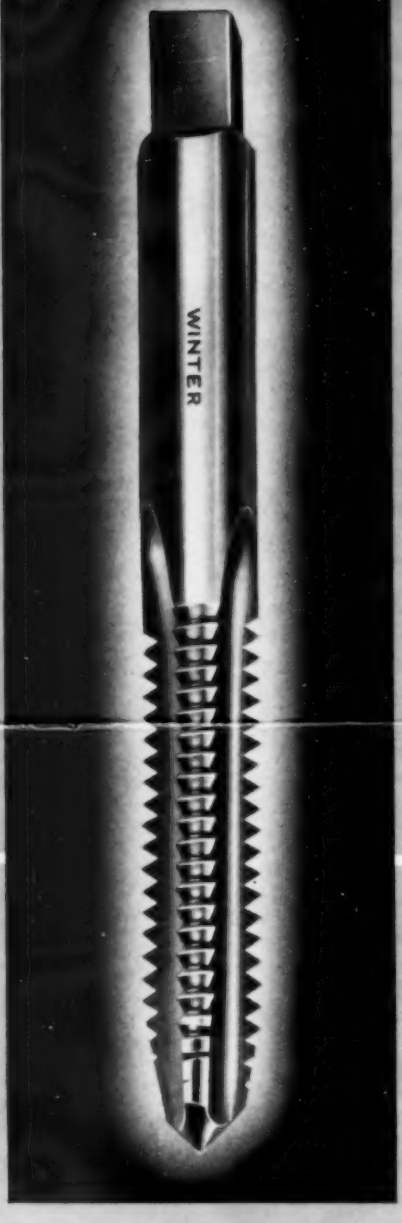
For TAPERED KEY-DRIVE SPINDLES

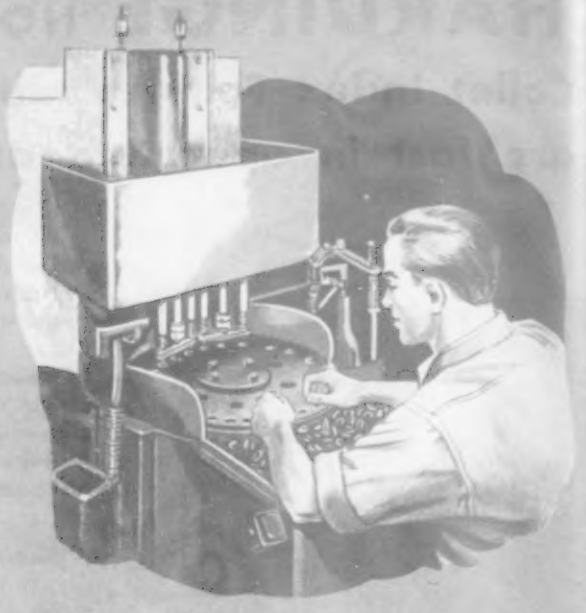
For THREADED NOSE SPINDLES



HARDINGE BROTHERS, INC., ELMIRA, N. Y.

OFFICES IN PRINCIPAL CITIES. Export Office: 269 Lafayette St., New York



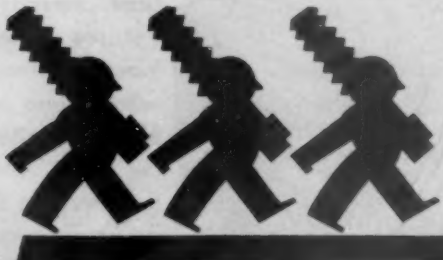


WINTER TAPS IN ACTION

WINTER STANDARD MACHINE SCREW TAPS are used in place of fractional size hand taps in sizes below ¼". They are available from No. 0 (0.60" diameter) to No. 14 (.242" diameter) in carbon steel. In high speed steel they are stocked as follows: cut thread and commercial ground from No. 3 to No. 14; precision ground from No. 0 to No. 14. Winter also offers machine screw series chip driver taps (spiral point) in sizes No. 3 to No. 14 for use in through holes and in thin materials, where breakage might occur with regular style taps. The complete Winter line includes chip driver, hand, nut, pipe, pulley, stove bolt, and tapper taps, and a full selection of dies.

ALWAYS AT YOUR SERVICE

YOUR LOCAL DISTRIBUTOR carries a complete stock of WINTER Taps on his shelves—as close to your tapping problems as the telephone on your desk.



WINTER

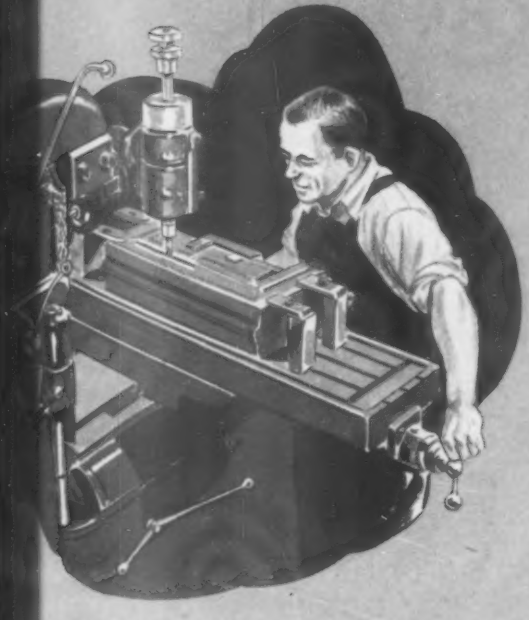
WINTER BROTHERS COMPANY • Division of the National Twist Drill and Tool Company

Rochester, Michigan, U.S.A. Distributors in Principal Cities • Branches in New York, Detroit, Chicago, San Francisco

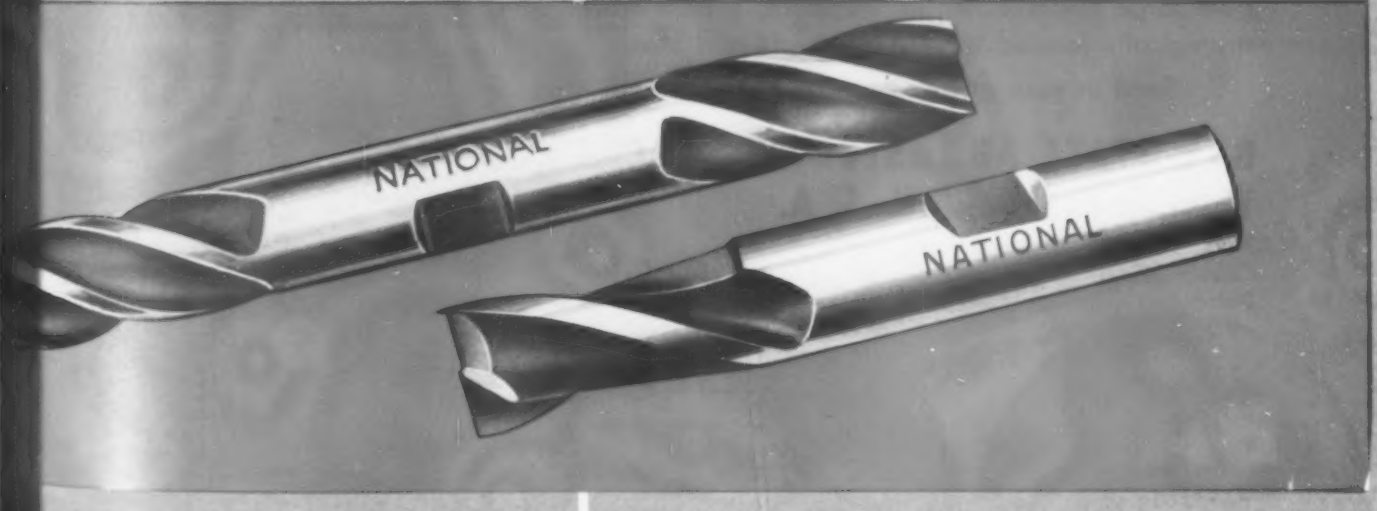
NATIONAL TWIST DRILL & TOOL CO. ROCHESTER, MICH., U.S.A.

National

METAL CUTTING TOOLS ON THE JOB



NATIONAL "HELEX" SINGLE END MILLS and DOUBLE END MILLS are recommended for milling slots, keyways and pockets, where arbor type milling cutters are unsuitable. They are designed with high helix angles of the cutting edges to promote smooth, efficient action. Because they are operated at high speeds, the danger of feed overload is lessened and breakage reduced. National also makes shell end mills, and taper and straight shank end mills. The complete National line of rotary metal cutting tools includes twist drills, reamers, counterbores, milling cutters, and hobs.



CALL YOUR DISTRIBUTOR

LEADING DISTRIBUTORS EVERYWHERE offer complete stocks of NATIONAL metal cutting tools. Call them for cutting tools or any other staple industrial product.

NATIONAL TWIST DRILL AND TOOL COMPANY • Rochester, Michigan, U.S.A.

Distributors in Principal Cities • Factory Branches: New York • Chicago • Detroit • Cleveland • San Francisco

Fourth in a series of Unusual Grinding Wheel Operations

KEEN EDGE MACHETES ARE A JUNGLE "MUST"

● This machete, known by the natives of Central America as the "Collins Knife", is used for slashing through jungles, on sugar and coffee plantations . . . and for self protection. It is sharpened to a razor-finish and is standard "dress" equipment for nearly all natives.

Whatever YOUR grinding problem may be, BAY STATE can solve it . . . fast. Possibly the exact specifications to meet your requirements can be supplied directly from large stocks either in Westboro, branch warehouses, or from our distributors strategically located throughout the United States.

Send us your grinding problems. We can help you.

BAY STATE ABRASIVE PRODUCTS CO.
Westboro, Mass., U. S. A.

Branch Offices and Warehouses —
Chicago, Cleveland, Detroit
Distributors — All Principal Cities

BAY STATE®

Top Performance Consistently Duplicated

MEMBER OF THE GRINDING WHEEL INSTITUTE

LOOK

at this hacksawing record!

PERFORMANCE of a single "JET-EDGE" Blade

MONDAY
40 pieces 3¼" Nitroloy

TUESDAY
50 pieces 1" x 5"
Cold Rolled Steel

WEDNESDAY
40 pieces 4½" 50 Carbon
Chrome Moly Steel

THURSDAY
10 pieces 4½" 50 Carbon
Chrome Moly Steel
12 pieces 6" Standard Steel Pipe
30 pieces ¾" x 5" SAE 1020

FRIDAY
4 pieces 6¾" Rytense

SEE what "Jet-Edge" can do for you.

In metal cutting, records like this mean money saved. "Jet-Edge," that rugged, unbreakable new blade with a super high speed edge welded to an extra strong back, will out-perform the best blade you've ever used. It will actually save you 20% to 50% on your power hacksawing costs, even under toughest cutting conditions.

WRITE for a free demonstration.

Find out *why* and *how*. We'll be glad to arrange a demonstration on your own work. No obligation — except an open mind for one of the most astounding performances you have ever seen.

MILLERS FALLS COMPANY, Dept. B
Greenfield, Massachusetts

MILLERS FALLS TOOLS

It's new!

It's "Jet-Edge"!

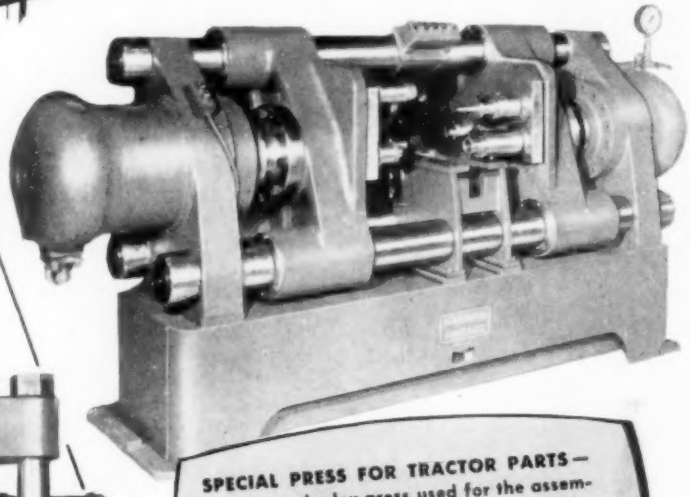
It's Millers Falls!

HANNIFIN *Engineered*—

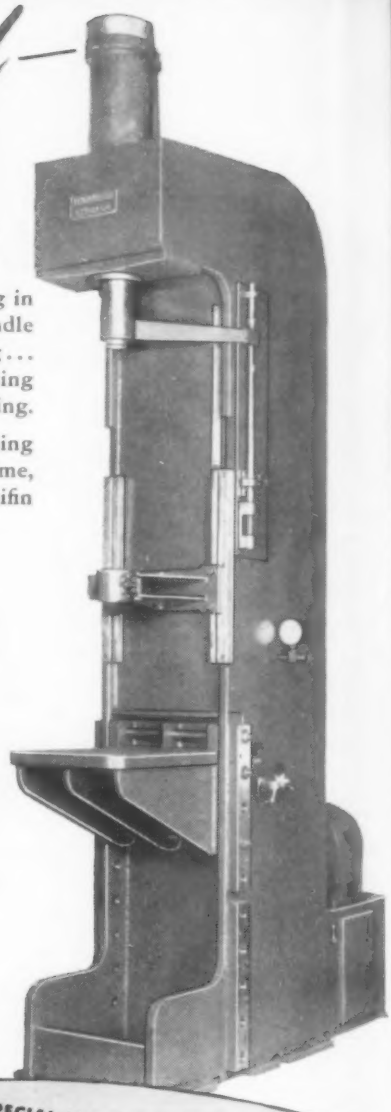
TO SOLVE SPECIAL PROBLEMS!

Here are typical examples of the work Hannifin is doing in building automatic and semi-automatic hydraulic presses to handle standard and special production jobs: press fit assembling... shaping...straightening...forcing...molding...riveting...testing ...loading...gear quenching...broaching...forming.

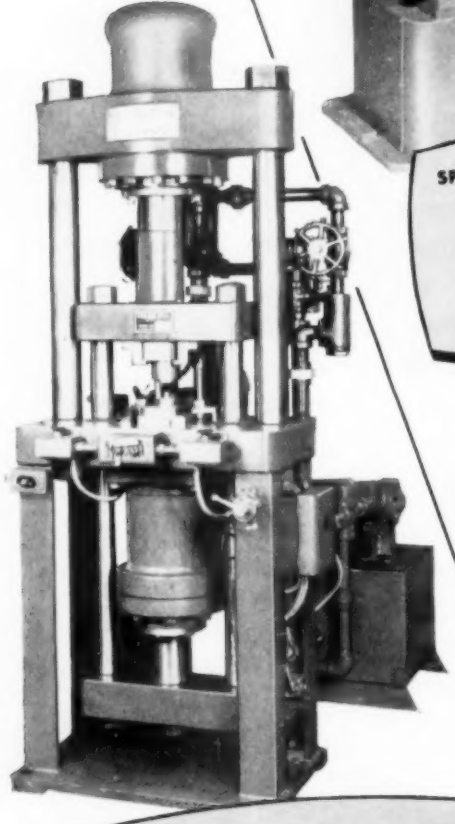
Hannifin offers an expert engineering service in designing and producing presses that can help you cut costs, save time, and do a better job. For recommendations, call in Hannifin engineers or submit specifications.



SPECIAL PRESS FOR TRACTOR PARTS—100-ton duplex press used for the assembly of track link pins for maker of crawler type tractors. Links are fed through and indexed. Left hand press ram advances, followed by right hand ram. Entire cycle is automatic.

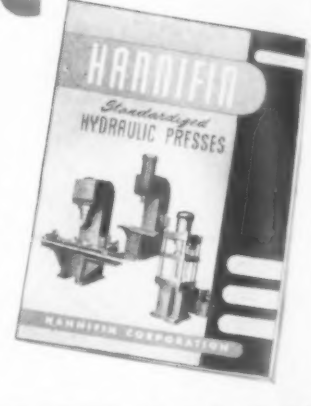


SPECIAL PRESS FOR TESTING AIRPLANE STRUTS—20-ton open gap Hannifin hydraulic press with table adjustable for height. Reciprocation of ram is automatic up to a rate of 20 cycles per minute. Accommodates struts up to 136" in length for testing.



SPECIAL PRESS FOR ELECTRIC MOTOR COMMUTATORS—30-ton press with 20-ton clamp cylinder below table. The lower cylinder clamps the work and the upper cylinder follows down and performs riveting operation. Reverses automatically when riveting is accomplished.

HYDRAULIC PRESSES



THE HANNIFIN line includes a total of 75 different standard models in sizes up to 150 tons. Hannifin design readily permits modifications or variations from standard at moderate cost. Table size, gap, reach, control equipment, and ram speed can be altered easily to suit special conditions. For detailed information, send for a copy of 20-page Bulletin No. 130

HANNIFIN CORPORATION

1119 S. Kilbourn Ave. Chicago 24, Illinois

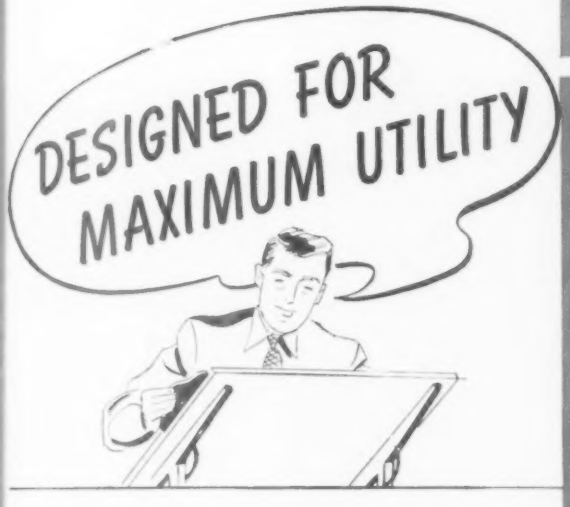
AIR CYLINDERS • HYDRAULIC CYLINDERS • HYDRAULIC PRESSES
PNEUMATIC PRESSES • HYDRAULIC RIVETERS • AIR CONTROL VALVES

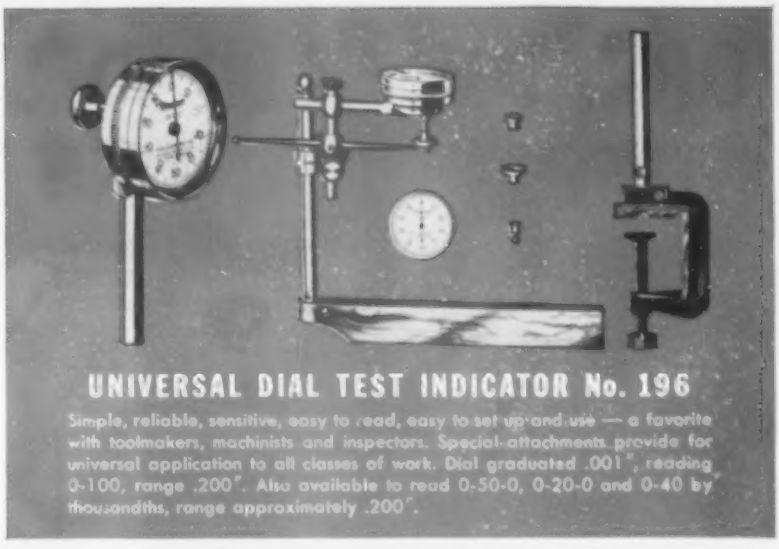
Nationwide Sales and Service

This advertisement appearing in: MACHINERY—*July;* AUTOMOTIVE INDUSTRIES—*July 15;* TOOL ENGINEER—*August;* AMERICAN MACHINIST—*September 8; and* PRODUCTION ENGINEERING & MANAGEMENT—*September, 1949*

Starrett

DIAL TEST INDICATORS





UNIVERSAL DIAL TEST INDICATOR No. 196

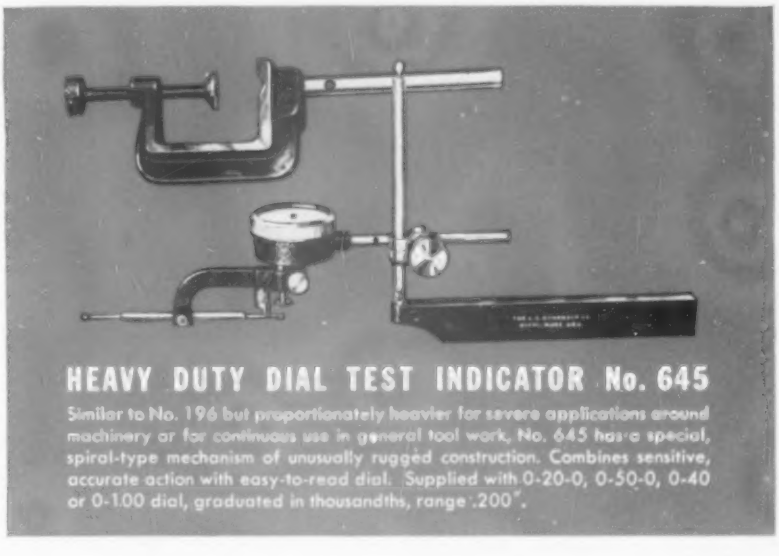
Simple, reliable, sensitive, easy to read, easy to set up and use — a favorite with toolmakers, machinists and inspectors. Special attachments provide for universal application to all classes of work. Dial graduated .001", reading 0-100, range .200". Also available to read 0-50-0, 0-20-0 and 0-40 by thousandths, range approximately .200".

DIAL TEST INDICATOR No. 665

A sturdy and heavier built combination for inspectors, erectors, machinists and toolmakers. Attachments providing for infinite adjustment include horizontal and right angle arm, tool post holder, keyway and guide stops. Choice of dial indicators.

DIAL GAGES FOR EVERY PURPOSE

The complete line of STARRETT Dial and Starrett "LAST WORD" Indicators includes models for every requirement. For complete information, write for Starrett Dial Indicator Catalog "E"



HEAVY DUTY DIAL TEST INDICATOR No. 645

Similar to No. 196 but proportionately heavier for severe applications around machinery or for continuous use in general tool work, No. 645 has a special, spiral-type mechanism of unusually rugged construction. Combines sensitive, accurate action with easy-to-read dial. Supplied with 0-20-0, 0-50-0, 0-40 or 0-100 dial, graduated in thousandths, range .200".

TRADE MARK Starrett REG. U. S. PAT. OFF.

Standard of Precision

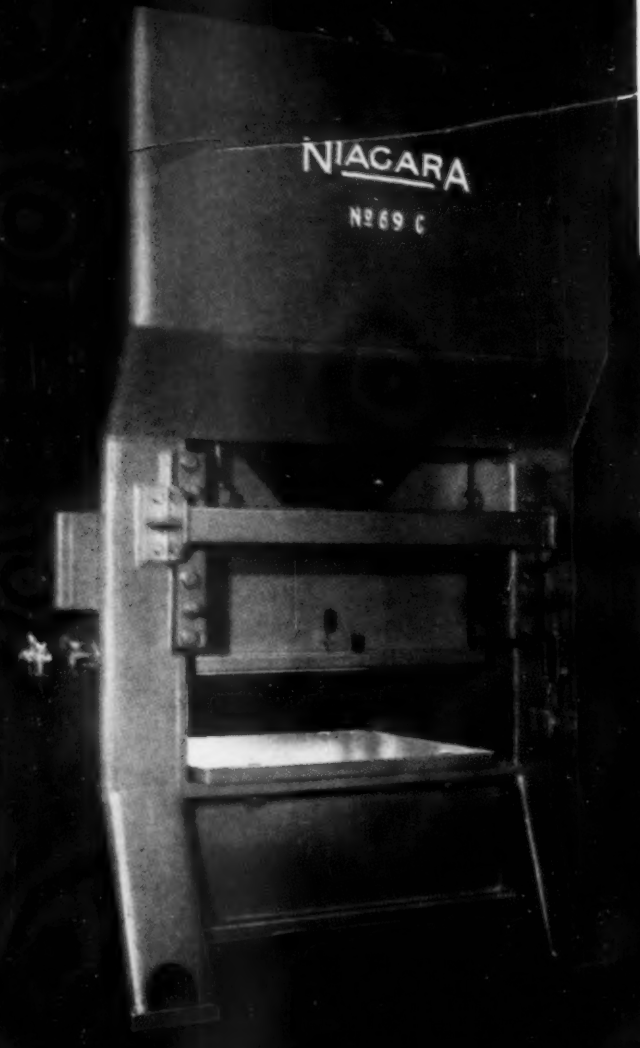
MECHANICS' HAND MEASURING TOOLS AND PRECISION INSTRUMENTS · DIAL INDICATORS · STEEL TAPES · HACKSAWS AND BAND SAWS · PRECISION GROUND FLAT STOCK

Buy Through Your Distributor

THE L. S. STARRETT CO. · *World's Greatest Toolmakers* · ATHOL, MASSACHUSETTS, U.S.A.

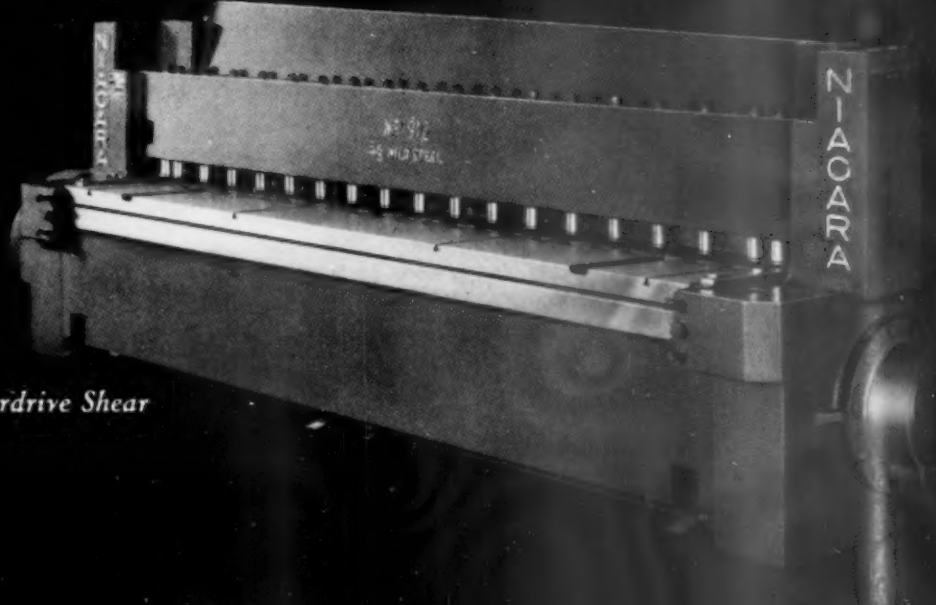
FOR ADVANCED DESIGN *look into....*

NIAG



Niagara Double Crank Press

Niagara Deep Throat Press



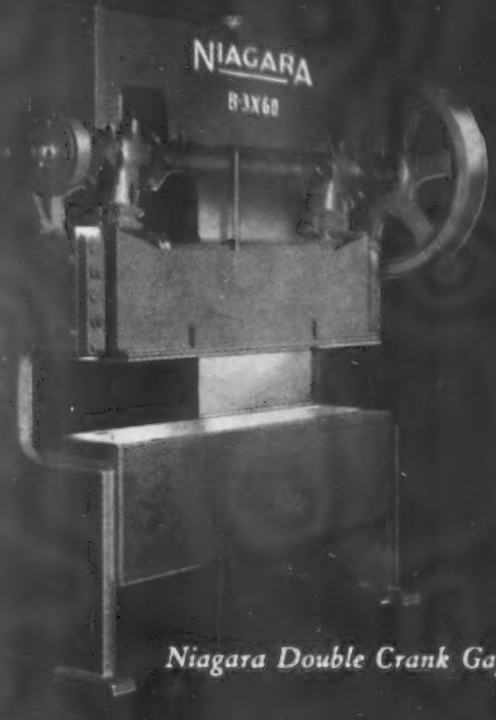
Niagara Underdrive Shear

NIAGARA MACHINE AND TOOL WORKS, BUFFALO 11, N.

NIAGARA

● The modern design of Niagara Presses, Shears and other machines for plate and sheet metal work is proof of the Niagara talent and experience that is built into them. Men responsible for economical production appreciate these results of Niagara engineering,—high hourly output...convenient operation...accurate work...reliable, uninterrupted performance with minimum down time...low maintenance cost.

Write for Bulletins

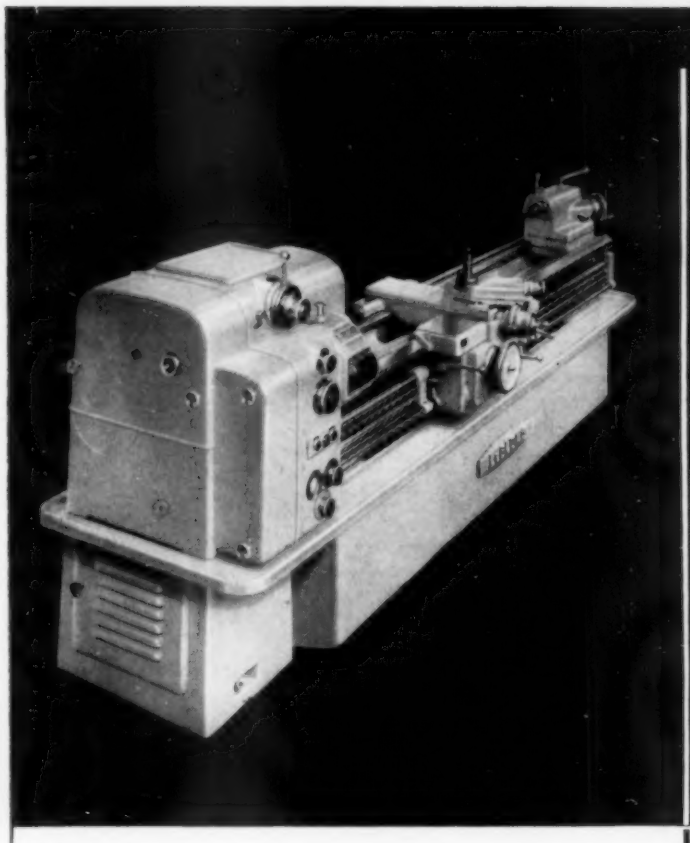


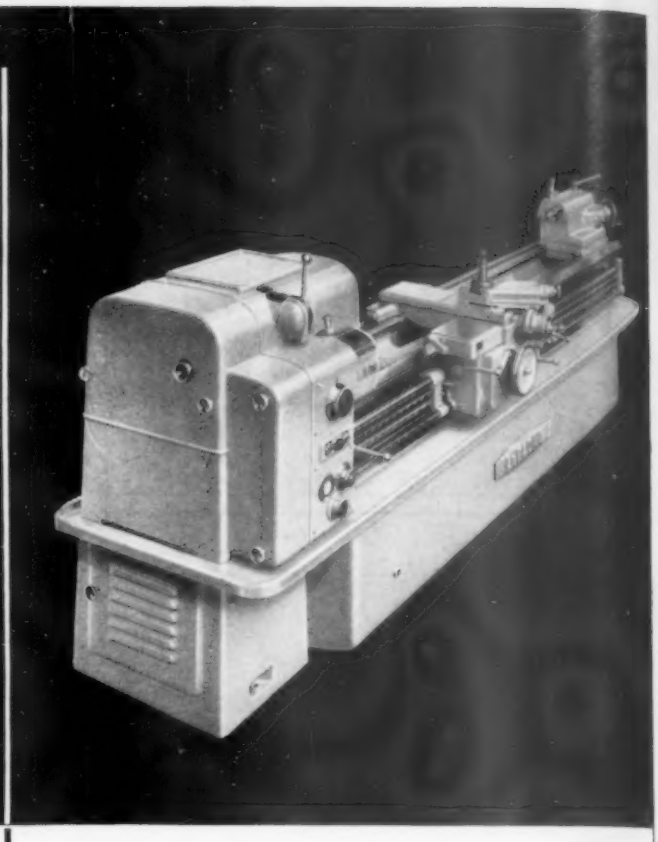
Niagara Double Crank Gap Press

America's most complete line of

PRESSES, SHEARS, TINNERS TOOLS AND MACHINES FOR PLATE AND SHEET METAL WORK

District Offices: Detroit, Cleveland, New York



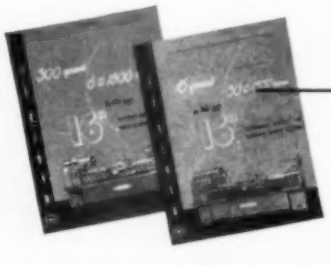


which is the better lathe for you?

16" LeBlond Model RT
Tool Room Lathe with over 300
spindle speeds 6 to 1500 rpm
obtained through variable speed drive.

16" LeBlond Model RT
Heavy Duty Engine Lathe
with 16 spindle speeds
30 to 1537 rpm or 20 to 1025 rpm.

The RT's represent an entirely new approach to engine and tool room lathe construction and operation. Utilizing the combination gear-belt drive headstock, they deliver speeds as low as 6 rpm and as high as 1537 rpm, can therefore perform a broader scope of work. Both are built with 4-directional power rapid traverse, enclosed quick change box, one-piece apron (combined feed apron optional), hardened and ground steel bed ways, thrust-lock tailstock with spindle travel dial, and many other modern lathe advantages.



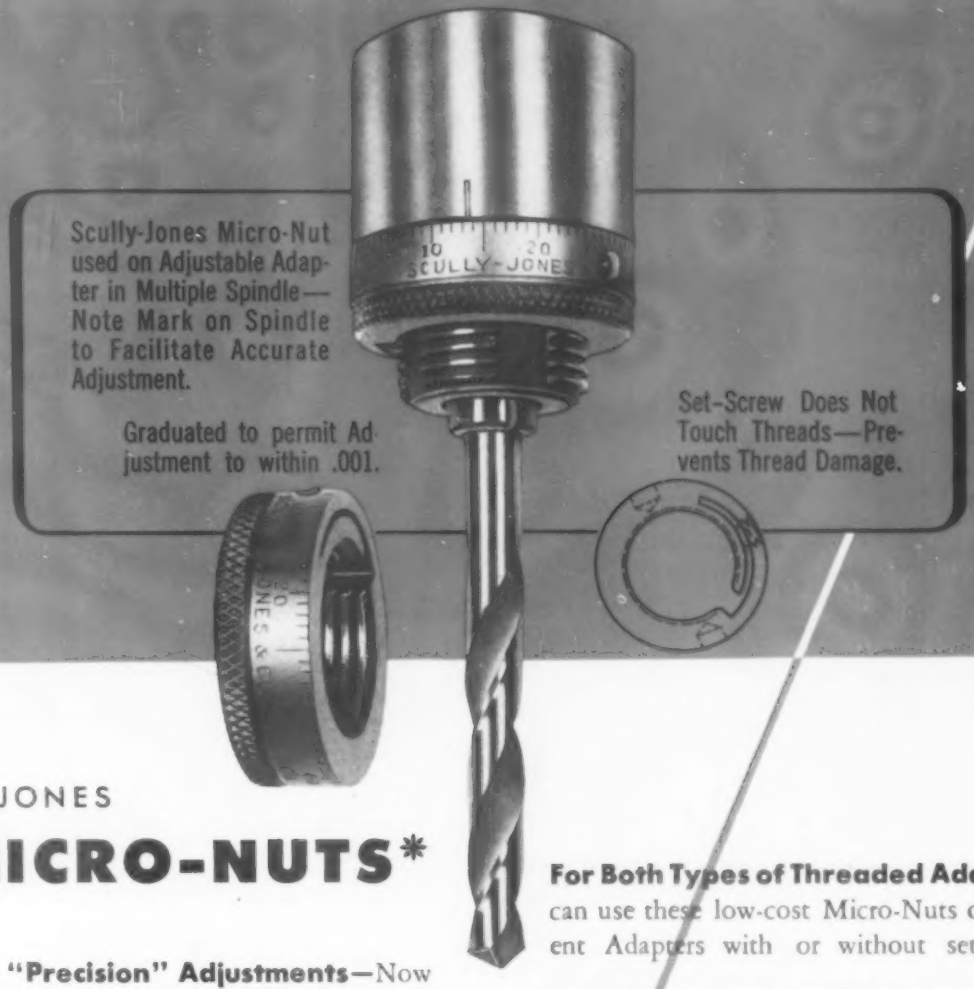
for complete information

see our catalog in Sweet's File for the Mechanical Industries, or send for bulletins RT-31 and HD-30-A.

THE R. K. LeBLOND MACHINE TOOL COMPANY, CINCINNATI 8, OHIO
LARGEST MANUFACTURER OF A COMPLETE LINE OF LATHES.
SALES OFFICES: New York, Philadelphia, Chicago, Detroit.

LeBLOND

PROVISION FOR PRECISION ON MULTIPLE SPINDLE MACHINES


Scully-Jones Micro-Nut used on Adjustable Adapter in Multiple Spindle—Note Mark on Spindle to Facilitate Accurate Adjustment.
Graduated to permit Adjustment to within .001.
Set-Screw Does Not Touch Threads—Prevents Thread Damage.

SCULLY-JONES

MICRO-NUTS*

You make "Precision" Adjustments—Now you can make really accurate adjustments on Multiple Spindle Machines to .001 in., by scribing a mark at any point on the Spindle (see illustration) and turning the easy-to-read, calibrated Scully-Jones Micro-Nut in the direction required.

You Save Set-Up Time—You simply give a quarter-turn to the set-screw, to lock Scully-Jones Micro-Nuts in place at any location on the thread of the Adapter. Note diagram showing that screw *does not touch* threads.

Keep Inventory Down—Your requirements will be filled immediately from our stock of all sizes for Adapters with "Acme" and "V" threads. Write for bulletin giving further details and prices.

R-2847RR

For Both Types of Threaded Adapters—You can use these low-cost Micro-Nuts on your present Adapters with or without set-screw slots.

Make Same Range of Adjustments—You can make the same range of adjustments, between spindle and work, with Scully-Jones Micro-Nuts as you do with standard solid adapter nuts.

Nothing to Get Out of Order—You will like the simple, trouble-free one-piece design, with vapor blast finish. Scully-Jones Micro-Nuts are machined and hardened to our high quality specifications, to assure you the service demanded by modern, high-speed production.

Scully-Jones AND COMPANY

1915 S. ROCKWELL ST.
CHICAGO 8, ILLINOIS

YOU GET LOW COST, FAST, ACCURATE PRODUCTION WITH OUR STANDARD AND SPECIAL TOOLS

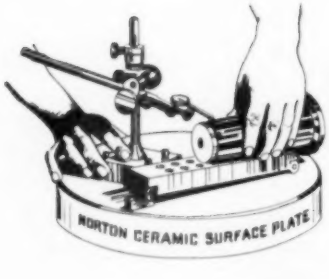
The Leader in Precision

The Norton CERAMIC Surface Plate

THE flat, smooth, wear-resistant surface of the Norton Ceramic Surface Plate has, in the few short months this plate has been on the market, established it as a leader in precision work. And in severe production gaging and blueing operations this ceramic surface plate shows to even better advantage.

You will find it to your advantage to use Norton Ceramic Surface Plates for these reasons:

1. ***Wear-resistance.*** Made of one of the hardest substances known, these plates can undergo months of severe use without measurable wear.
2. ***Flatness.*** Guaranteed to be flat within .0001", the Norton Ceramic Surface Plate assures perfect accuracy of precision measuring operations. And it stays flat because it will never warp nor deform; it gives no expansion troubles and will not deflect under load.
3. ***Smoothness.*** The Norton Ceramic Surface Plate offers a new standard of continuously smooth surface finish that allows easy movement of instruments and work across the plate and prevents wear of expensive instrument bases, gage blocks and sine bars.



In addition to these three advantages, the Norton Ceramic Surface Plate has other important qualities: it is ideal for blueing; it will not corrode; and it is non-magnetic.

NORTON COMPANY
Worcester 6, Massachusetts

For more information on the longest-wearing precision surface plates ever made, write Norton Company, Worcester 6, Massachusetts, for Bulletin No. 1174.

NORTON

CERAMIC SURFACE PLATES

NIAGARA

Announces a New, Low-Priced

POWER SHEAR FOR LIGHT SHEET METAL

Here is the new high speed Power Shear sheet metal men have been waiting for. advanced engineering... new styling ew, easy, fast operation.

THE GREATEST OLLAR for DOLLAR SHEAR VALUE OUR MONEY CAN BUY

his new Niagara high speed er Shear is designed for light metal work. One look at its active styling indicates its mod- performance.

bricated from unbreakable plate, it is engineered to com- strength and stiffness for accu- cutting.

ear visibility of cutting line gh cut-outs and over the top oldown facilitates shearing to ccurate layout line.

agara Alloy Tool Steel Knives treated to a high degree of dness and toughness and pre- on ground for accuracy provide keen cutting edges for longer service ween grinds.

Quick Acting Back Gauge and convenient front and side gauges.

Capacity—20 gauge.

30, 36 and 42 inch cutting lengths

125 cuts per minute.

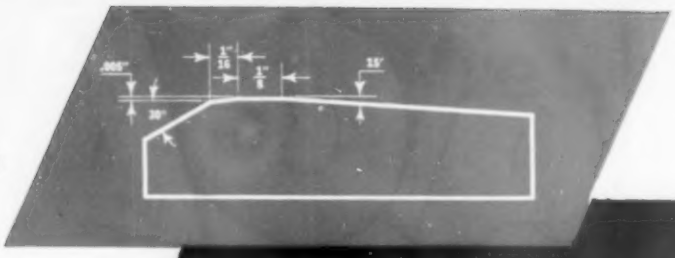
Write for complete information and low prices

See how the new PANCAKE MOTOR DRIVE provides the most compact construction ever obtained... minimum floor space, maximum safety.

IAGARA MACHINE & TOOL WORKS • BUFFALO 11, NEW YORK

DISTRICT OFFICES: DETROIT • CLEVELAND • NEW YORK

this form



MEANS LONGER TOOL LIFE REAMING SOFT MATERIALS

Soft steel tubing, stringy and tough, is no match for Barber-Colman Reamer life on this job. First of all the right chamfer and back taper for reaming this material produces a tool that removes the chips "free and easy", leaving the quality of finish desired.

Then, Barber-Colman automatic form-cam sharpening guarantees consistent resharpening of the blades to the same clearances and tolerances, leaving no guess work or hand stoning to mar blade life or work finish.

Irregular blade spacing, arranged so that the O.D. can be checked across any 2 blades, prevents chatter and the tendency to produce welts in the hole.

With correctly designed tools, easily and accurately resharpened, there can be no problem of finish or tool life. And when the reamers have served their useful life, the used blades can be scrapped and new ones inserted. Why not see what excellent finish and tool life you can get with Barber-Colman Inserted Blade Reamers.

JOB FACTS

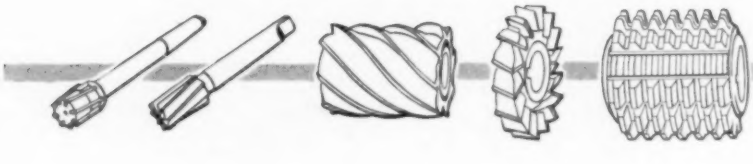
Operation — Ream Axle Bushings
Material — Soft Steel Tubing
Stock Removed — .020"
Tool Life — 150 pieces per sharpening
Accuracy — Size within .0015"
Finish — Smooth, free from marks

FREE

Write for additional Data Sheets covering other reaming applications and performance figures. Ask for Series No. 5442.

Barber-Colman Company

GENERAL OFFICES AND PLANT, 5442 LOOMIS ST., ROCKFORD, ILLINOIS, U. S. A.



BARBER COLMAN

Product Design and Its Relation to Milling Cutter and Machine Selection

By Mario Martellotti

DEVELOPMENT ENGINEER
THE CINCINNATI MILLING MACHINE COMPANY

IN THE DEVELOPMENT of a product, close consideration should be given to the design of its component parts so that they may be manufactured quickly, accurately and at a minimum cost with the most efficient combination of machines, milling cutters, and fixtures.

To accomplish this result, it is necessary to know the characteristic features of the available milling machines of standard design in order to know which type of machine may be best fitted for the job at hand. In addition, one must be acquainted with the operating characteristics of milling cutters in terms of their metal removal ability; ease of application and maintenance; the finish produced on the milled surface and the cutter life in relation to type of operation, cutter material and material to be cut and the number of parts to be milled; as well as the effect which the design of a part may have on fixture design and its cost.

Milling Machines

The majority of production jobs are done on standard milling machines equipped with hand or automatic fixtures to hold the workpiece. Standard milling machines, with the aid of fixtures and other accessories can often be adapted, with a minimum of capital investment to meet the changes in product design dictated by changing market conditions. Standard milling machines have an inherent flexibility which makes possible with proper tooling to perform a variety of milling operations, from the simple milling operation of plane surfaces to the automatic milling of a complicated pattern such as is encountered in working out dies and molds. Thus the designer is provided with greater freedom in the choice of his design of a part than could have been possible not long ago.

Standard milling machines are utilized to quickly start production on a new article while determining the selection of a specialized machine. These may be of the semi-special or special type designed to obtain the ultimate in production on a specific operation on a specific part with a minimum operator fatigue. Special or semi-special milling machines do not, however, have the flexibility of adaptation to changes in production that is a characteristic feature of standard machines.

From an economic viewpoint, therefore, the use of semi-special and particularly special machines is justified as long as this equipment can be amortized in a relatively short time out of savings in production cost effected through its use, so that when market conditions change, new equipment can be purchased without incurring too great a loss of the invested capital.

Sometimes, special multi-station automatic machines composed of individual machining units performing a number of different machining operations such as milling, drilling, reaming, spot facing, etc., in a synchronized sequence are used in the production of large quantities of parts. The various machining units are actually separate machines mechanically combined in one unitary machine, in which the work piece is transferred automatically from one station to another in a predetermined sequence without assistance from the operator, except for placing the work piece in the loading station. Because of this feature, these machines are known as transfer machines.

Transfer machines are advisable only when careful studies indicate that their use is practical and profitable. Some of the advantages to be gained from their use include:

1. Reduction in the number of operators and machines required for any given job.

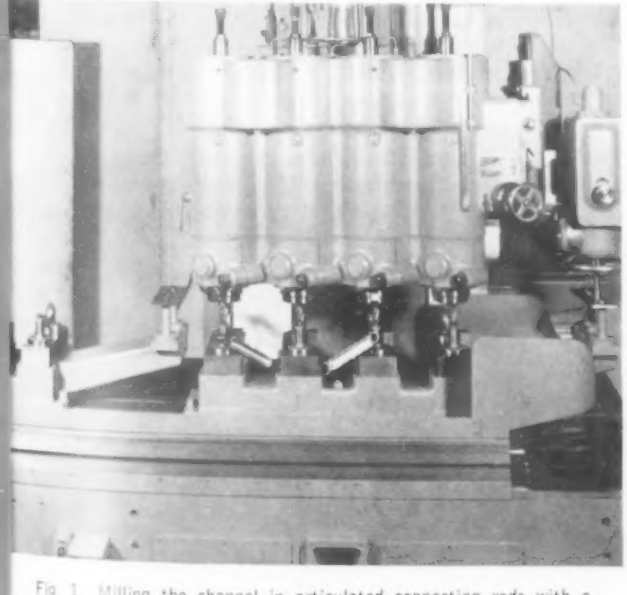


Fig. 1. Milling the channel in articulated connecting rods with a round nosed end mill on a four-spindle profiling milling machine.

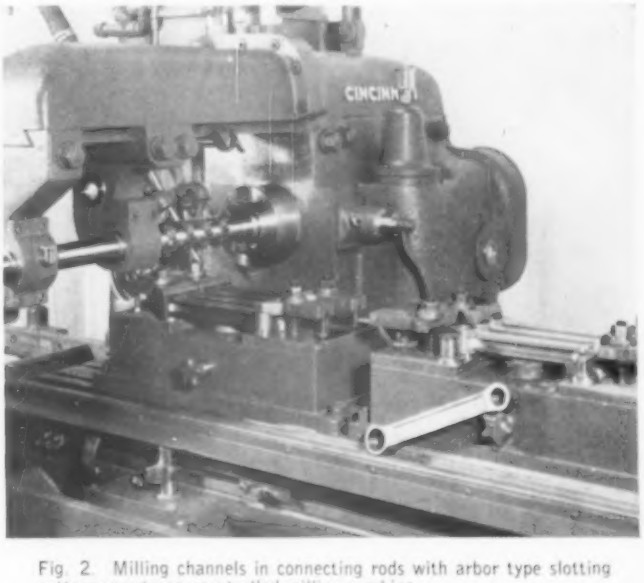


Fig. 2. Milling channels in connecting rods with arbor type slotting cutters on a tracer-controlled milling machine.

2. The machine can be operated by semi-skilled operators, thus reducing labor cost.

3. Reduction in cost per piece machined.

The use of transfer machines is favored by economic and production factors like these:

A. High labor cost

B. Large quantity production

C. Infrequent changes in the design of a product

D. Low interest rate on capital investment

E. Low property tax

Considerable progress has been made in the development of milling machines, to a point where it is now possible to perform milling operations with a high degree of accuracy and quality of finish, that until relatively recently could be only roughly machined, and finished by tedious hand-work. It is still necessary to exercise good judgment in product design to avoid increasing the cost of the operation by requiring special devices or attachments and/or the use of cutters not particularly suitable for the operations from the viewpoint of cutter life and quality of finish of the milled surface, as illustrated in the following examples:

Milling Connecting Rods

Some articulated connecting rods for radial aircraft engines are made to an H-shaped section. The surfaces of the channels must be machined to exacting dimensions and high quality of finish.

In one design of connecting rods the channel section has the form of an elongated pocket with rounded ends. To mill the inside and the bottom surfaces of the channel, including the end surfaces at the given radius, an end mill with a round nose is used, having a diameter corresponding to the radius of the rounded ends of the channel. This is the only type of cutter that will permit completing the milling operation of this type of channel design without requiring changes in either setup or the type of cutter. The equipment and the setup for this operation are shown in Fig. 1. The various surfaces are milled by profiling around the pocket on a four vertical spindle tracer controlled milling machine at a rather slow feed rate to avoid cutter breakage.

With this method the production rate is low, and the finish of the surface shows pronounced tooth marks and revolution marks which are subsequently removed by

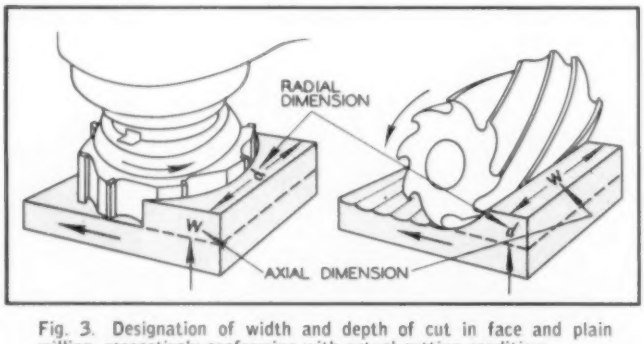


Fig. 3. Designation of width and depth of cut in face and plain milling, respectively conforming with actual cutting conditions.

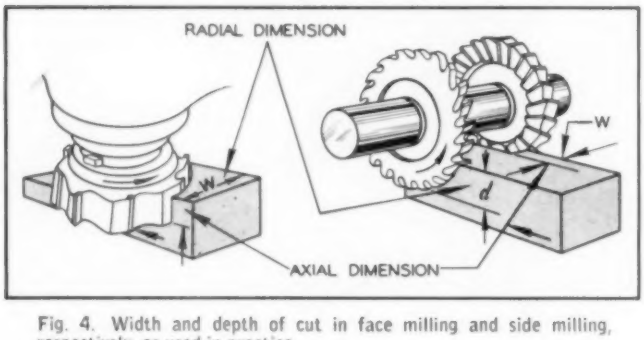


Fig. 4. Width and depth of cut in face milling and side milling, respectively, as used in practice.

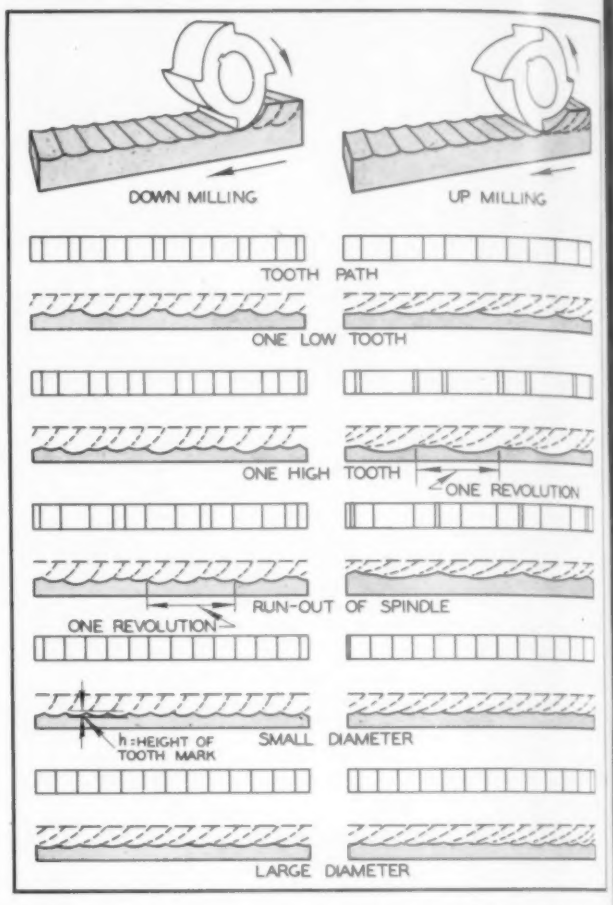


Fig. 5. Greatly enlarged outline of milled surfaces generated graphically in up-and-down milling for various assumed conditions.

lengthy polishing. Further losses in production are caused by frequent machine down-time to change cutters. The cutter life of a round-nose end mill is rather short due to wear on the cutting edge along the radius. This adds to a high cost per piece. A high production rate can be achieved only by considerable investment in machines, cutters and cutter grinding equipment and with a corresponding increase in the labor required for the operation of this equipment.

In another design of articulated rods, the channel runs out to the ends through surfaces of large radii which are the continuation of the bottom surface of the channel. This modification in design permits milling the channel with a slotting cutter, mounted on the spindle of a tracer controlled milling machine (Fig. 2). The result is higher production with less costly equipment.

As the workpiece is fed past the cutter, a tracer in contact with a template of the longitudinal contour of the channel moves the spindle carrier and the cutter vertically in synchronism with the contour of the template. The two large radii, the bottom surface and the sides of the channel section are milled in a single pass and at a much faster feed rate than is possible with end mills.

An appreciable increase in production results from the saving in time for the operation, reduction in the frequency of machine down-time due to increased cutter life from the better cutting conditions, and corresponding more efficient metal removal obtainable with a slotting cutter. In addition, less polishing time is required because of the better quality of fiinsh of the milled surface produced by a slotting cutter. Thus, detail of design based on the knowledge of the potentialities of available milling equipment, together with the proper selection of milling cutters will make possible increased production, improved finish and dimensional accuracy, and lowered cost of a milling operation.

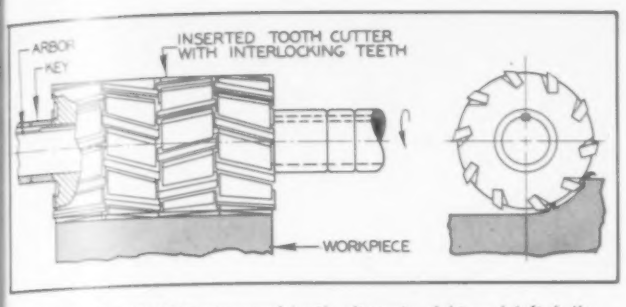


Fig. 6. Combination staggered-tooth alternate right and left helix cutters for mounting on an arbor in heavy slab milling operations.

Milling Cutters and Type of Operation

In tooling for milling operations, a question may arise as to the best type of milling cutter to use in a specific milling operation—

Milling Plane Surfaces

To mill plane surfaces two types of cutters are available: face mills and plain mills.

Both cutters remove metal by the action of the teeth on the periphery and the difference between the two types of cutters is that:

With face mills the bulk of stock is removed by the cutting edges of the teeth on the periphery, while the cutting edges of the teeth on the face of the cutter produce the finish of the milled surface by removing only a small thickness of material:

With plain milling cutters the bulk of the material as well as the finished surface is produced by the cutting edges of the teeth on the periphery.

Comparing face mills and plain mills on the basis of power used for any given rate of stock removal, actual data show that:

The width of cut in face milling has the same effect on power as the depth of cut in plain milling, while the depth of cut in face milling is equivalent to the width of cut in plain milling. Thus, from the viewpoint of metal removal the only difference between face milling and side or plain milling lies in the designation of the width and depth of cut, as indicated by the letters W and D respectively, Fig. 3.

In practice the designation of width and depth of cut for face and plain milling is as shown in Fig. 4. From the shop standpoint, this designation is to be preferred be-

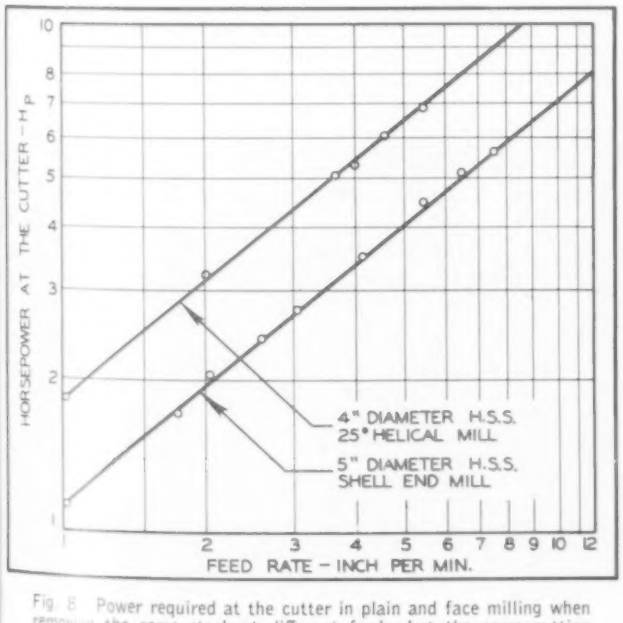


Fig. 8. Power required at the cutter in plain and face milling when removing the same stock at different feeds, but the same cutting speed on a SAE 3140 steel block.

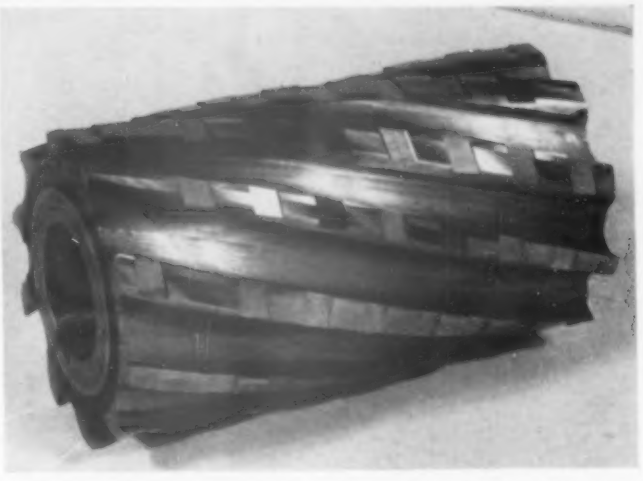


Fig. 7. Plain milling cutter showing staggered relieved portions to materially improve metal removal efficiency and performance of the cutter.

cause the depth of cut is always that machine adjustment which is made at right angles to the cutter, regardless of the position of the cutter axis.

Plain milling cutters, also known as slab mills, are especially useful when taking deep cuts in heavy milling operations, or in combination with other cutters as in gang milling to perform simultaneous milling operations.

This is a distinctive feature of arbor type cutters, and is particularly valuable in production runs, because substantial savings can be effected both in equipment and in machining time. The surface finish is affected by the geometry of the process and is the result of a combination of innumerable elemental surfaces generated by individual cutter teeth.

In the range of feeds per tooth commonly used in milling operations (0.005 to 0.10 in.), the mark of each individual tooth is not visible to the naked eye, but becomes distinct at higher feeds per tooth. In addition to the tooth marks, a surface milled with a plain milling cutter may show periodic variations having a wavy appearance, and recurring with the frequency of the cutter revolutions per minute. These marks are commonly known as revolution marks. The tooth marks follow the undulation of the revolution marks, which are high tooth marks.

The presence of tooth and revolution marks alters the geometry of the surface (Fig. 5) and consequently the quality of finish. The magnitude of the tooth marks can be reduced by increasing cutter diameter and decreasing

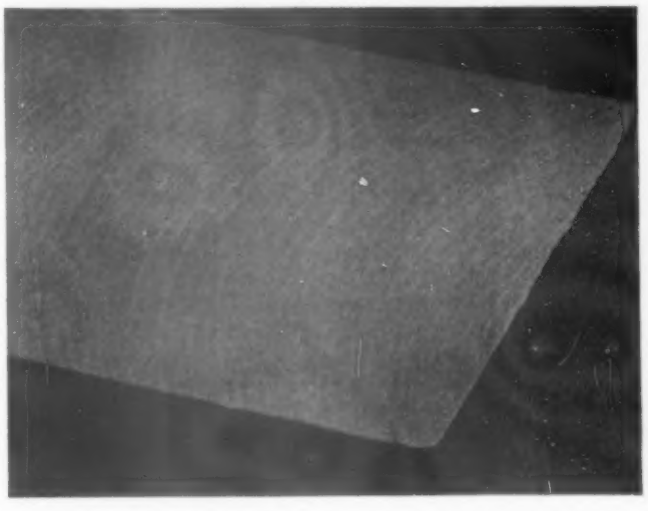


Fig. 9. Surface produced by a high speed steel face mill on a cast iron block—Magnification 1½x.

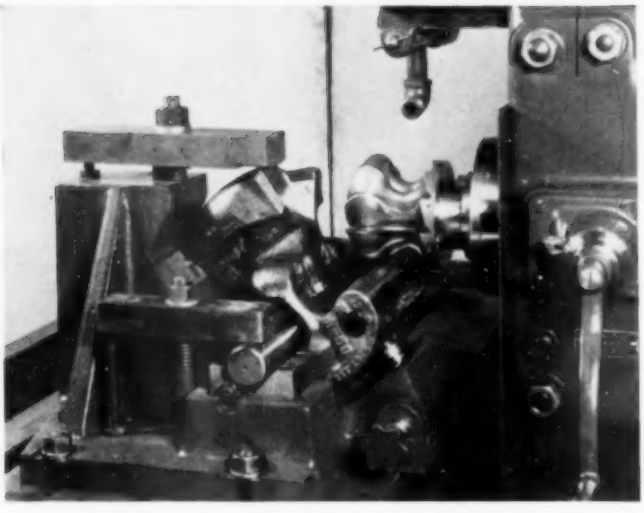


Fig. 10. Shaped profile cutter, to mill the contour of a railroad car coupler.

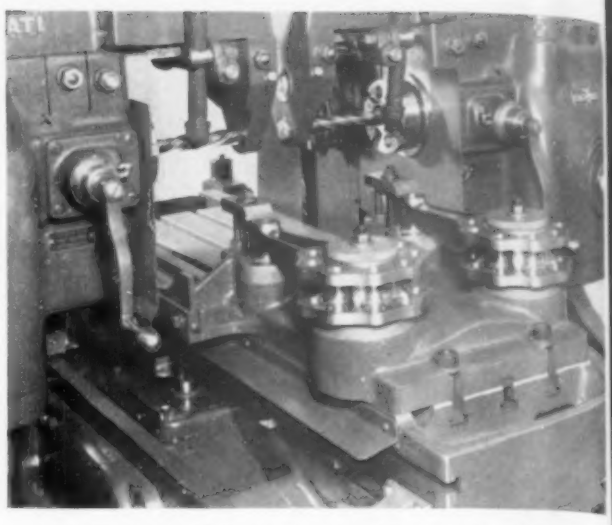


Fig. 11. Standard helical mills are used in milling the edges of the H section of master rods on a standard tracer-controlled milling machine, thus avoiding the use of complicated gang of cutters.

the feed per tooth, while the revolution marks can be reduced by grinding the cutter teeth to close limits and by making sure that cutter run-out is reduced to the possible lowest amount.

For heavy slab milling operations, cutters of the inserted tooth type are used. These are made of short sections (Fig. 6) mounted on the arbor, with the teeth staggered and overlapping with alternately right and left hand helix to break up the chip length. This design is more efficient and provides better performance than continuous tooth slab mills.

In the case of a single plain milling cutter, an equivalent result may be obtained by reducing the cutting edge length. This is done by grinding relieved sections in each tooth overlapping with those in adjacent teeth (Fig. 7) so that the relieved sections are staggered.

The reduction in length of the cutting edge is particularly effective in lessening the tendency of the cutter to "chatter". *Face milling cutters* are useful in the removal of metal in moderate thicknesses and wide widths. Face mills are more efficient in removing metal than plain mills. (Fig. 8). The saving in power can often be utilized to increase the production rate by increasing the feeding rate of the machine. In the case illustrated in Fig. 8, a plain mill and a shell end mill remove the same stock measuring ¼ in. depth and 4 in. width of a SAE 3140 steel, at different feed rates and same cutting speed. A saving of approximately 45 percent is obtained when the operation is performed by face milling.

Face milling cutters should be used whenever possible in milling plane surfaces, in preference to plain mills. They are more efficient, produce better finish and more accurate surfaces than plain mills. (Fig. 9.)

Simultaneous milling operations cannot be performed with face mills as conveniently as with arbor type cutters because for any additional face mill an additional machine spindle is required. When the number of spindles required is above two (the number available in duplex type milling machines) the milling machine becomes of the special type, which is usually more expensive and not as readily available as a standard machine.

Milling Curved Surfaces

When milling curved surfaces or surfaces of complicated contours (Fig. 10), standard half-round formed relieved cutters are used. It is, however, desirable on the basis of cost and maintenance of the accuracy of the contour when resharpening the cutter, to select shaped profile cutters. The contour of these cutters can then be ground accurately on a contour cutter grinding machine each time the cutters are sharpened.

Cutters of complicated contours should be avoided, however, if the milling operation can be performed by a different method with cutters of simpler contour. In milling, for example, the edges of the H section of a master rod and the radii at both ends, standard type helical mills with a pilot end are used in place of a gang of cutters, made to the contour of the cross-section to be milled. This simplification is made possible by the selection of a standard tracer-controlled duplex milling machine (Fig. 11), in which a template of the contour to be milled guides the cutters along their path as the parts are fed to them at the feed required to meet the needed production rate.

In milling recesses having complicated contours as, for example, in master rods (Fig. 12) this operation can be performed on a 360 deg tracer controlled profiling machine, by using end mills. The path of the four cutters is guided by means of a tracer in contact with the template of the contour to be milled, shown at the right in Fig. 12.

Four templates are provided for this operation, which is completed in four steps. Three templates are used to mill the bottom of the recess in incremental cuts, and the fourth template is used to control the cutters when finish-milling the sides of the recesses. This equipment permits performing the operation automatically and quickly within the required degree of accuracy.

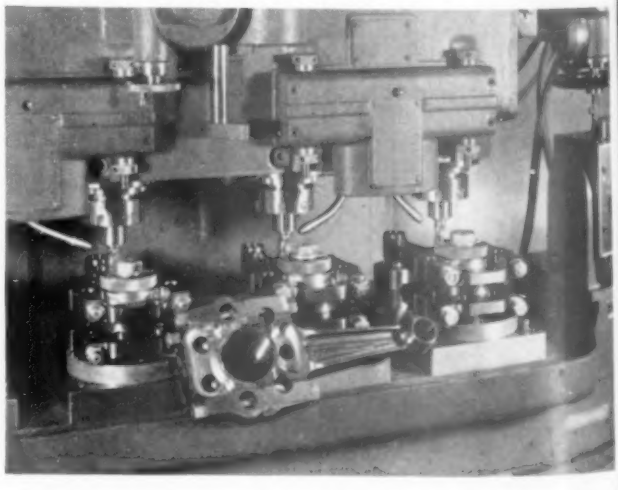


Fig. 12. Milling recesses of complicated contours by means of end mills on a 360 deg tracer-controlled four-spindle milling machine.

By Ralph M. Shaw, Jr.
PRESIDENT, PEDRICK TOOL & MACHINE CO.

Fundamentals of Compression Bending

THE ART OF BENDING is a subject about which relatively little is known. From a structural point of view, the cold fabrication of which cold bending is one class obeys the same laws as does the structural engineering profession with the following exception: structural engineering operates on the stress-strain curve below the elastic limit, whereas cold bending operates on the same curve above the elastic limit.

The formula which we all learned in our first course in engineering is the basic one in cold bending:

$$F \text{ equals} \frac{M \times Y}{I}$$

where F is the tensile strength at yield, M is the bending moment, Y is the distance from the neutral axis to the outer most fibre, and I is the moment of inertia.

$$\text{Since} \frac{I}{Y} \text{equals the Section Modulus S, then}$$

$$F \text{ equals } \frac{M}{S}$$

The value S may be found in any handbook for ordinary shapes, or may be easily calculated by well established formulas. In addition, F can be supplied by the distributor of the material being bent, so, by inserting these values in the above formula, M, the bending moment, can be calculated. All bending machines are merely devices for applying a bending moment. What is done with this moment determines the kind of bending that is to be used.

There are four established methods of bending pipe and shapes.

a. The compression process.
b. The draw process.
c. The roll process.
d. The ram process.

A fifth process, the tension process, is an adaptation of the compression process. This is also known as the stretching process used on bending shapes, which differs only in that after the bend is made, it is stretched to set it to the die.

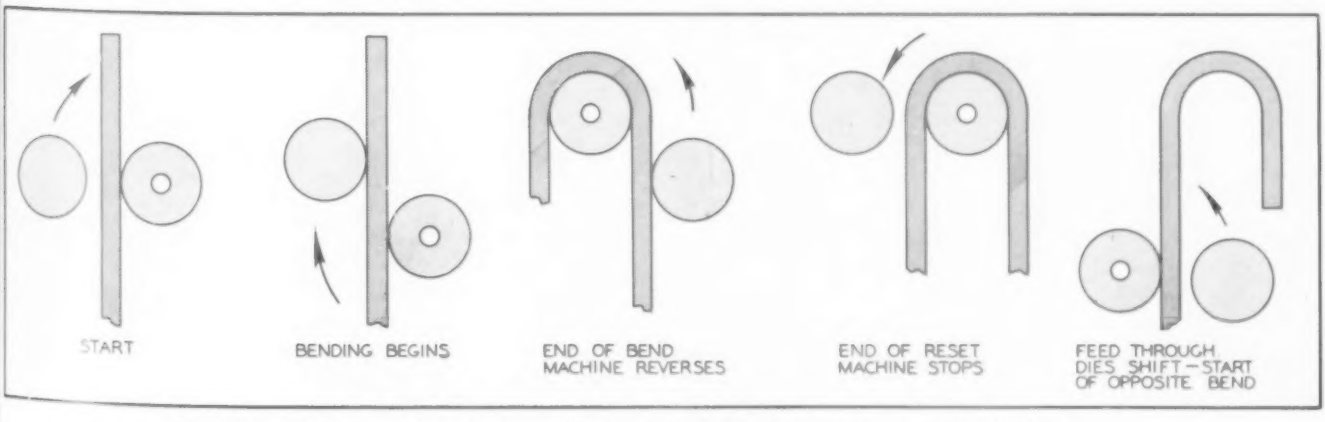
In the compression process, the die is stationary and the roll wipes the piece being bent into the die. No clamps are required and the piece being bent does not move forward or creep under ordinary conditions. When the radius becomes so close that a kink is formed, clamping must be resorted to but this is an exceptional case and out of the ordinary. In the compression process, the neutral axis is on the outer third of the section. The inner wall of the pipe being bent is considerably thickened, the outer wall only slightly reduced in section, and the resultant strength increased due to the increase in tensile strength due to cold work.

In the draw process, the die rotates. The piece being bent is clamped to the die and is drawn over a roller or against a shoe similar to the winding of thread over a spool. In this case, the neutral axis exists on the inner third of the section, the outer section of the pipe is greatly reduced and the inner wall is only slightly increased in thickness. The resultant strength is reduced because, even though the tensile strength increases due to cold work, the reduction in section of the outer wall is greater in percentage than the increase in strength.

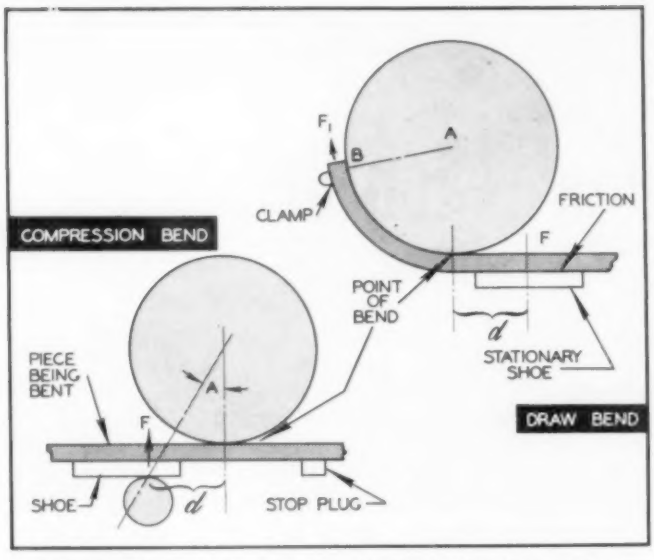
The roll process is identical to the action of a rolling mill except that the rolls are not set for straight production but rather are set so as to cause a deflection in the piece being rolled. This gives by far the most accurate bend and has the least flattening effect, but the radii obtainable are substantially greater than those obtainable by the other two processes.

The ram process is merely the supporting at both ends of the piece being bent and the application of a force in the middle. It is used for large diameter pipe, and where the accuracy of the bend is of no moment, and where a full 180 deg is not required. In order to get a full 180 deg, it is necessary to use extra equipment. The structural formulas controlling it are merely those of a simple beam.

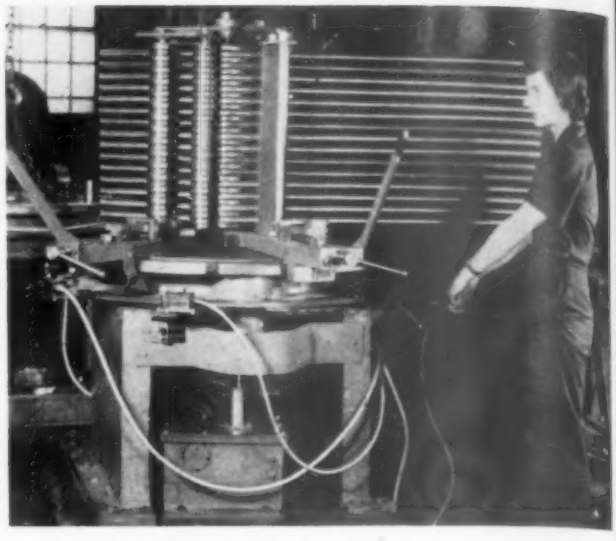
The compression process is used for production, where the wall is relatively thick in the case of pipe and tube, and where the radius is not too close. Its limiting factor is the flattening effect of the pipe or tube, and the wrinkling of same. Bars and shapes may be bent to a square corner. In the case of angles and flats bent the hard way, the limiting radius at this writing is about the same as the width of the flange in compression measured to the inside edge of the section in compression. When bent with the flange out, the limiting radius is the width of the flange in tension measured to the inside edge of the web. For bending pipe and tube, it is possible to use an internal receding mandrel for close radii and get a good bend, but this is a specialized case.



From left to right above are shown the consecutive steps in bending a section with the compression bending process.



Primary difference between a draw bend (right) and compression bend (left) is seen here.



Compression bending becomes a production process in application such as this for multiple bending.

The draw process is used for production where the wall of the tube is thin, or the radius is close, or both. The flattening effect of an unfilled tube is about double that of the compression process so that an internal mandrel is always used with this equipment. Since the tube is wound onto the die over this mandrel, the effect is to draw it over the mandrel, hence the name. The limit to the radius is the draw of the material and when this is too thin, the material breaks at the periphery of the bend, thus establishing the limit. Since the process is one of drawing the metal, only materials of relatively high ductility may be bent. This is true for bending bar stock as well as tube.

The roll process is used for bending coils of the helical type from either bar stock or tube, and the effect is to produce a coil of small flattening and generally perfect shape without additional equipment or subsequent work. It is not generally employed for making ordinary right angle bends because the production is low and the tangent on the end of the piece is larger than that required on a die type bender.

The ram bender is used where the first cost must be low and the radius large, and where the accuracy of the bend is not important. Ram machines are available whose first cost is about one tenth that of compression or draw machines, and find their use in maintenance work where a bender is used once and then put on the shelf for months before being used again. They are not often used for production because the tolerance is poor and the breakage is apt to be high.

One of the failures in tube bending is the wrinkle effect. This exists on the inner edge of the bend and the thinner the section and closer the radius, the greater it becomes. It is evident in shapes as well as tube, and appears on the compression flange of an angle of flat. Indications exist that it obeys the column formula in structural engineering, but this has not yet been proven. That is to say:

$$F \text{ equals} \frac{M}{S} - \frac{K \times L}{R}$$

where L is the length of section unsupported which in this case is very small, R is the least radius of gyration, and K is a constant determined by the material in question. When the values of these two factors become equal, F becomes equal to zero and failure results through wrinkling.

Another interesting phenomenon in bending is the apparent time constant theory. Metals apparently exist in two forms: the ordinary crystalline condition, and an amorphous condition similar to a eutectoid. It is well known that, on heating metal to a certain point, it passes from the crystalline condition into a eutectic. The reverse is true on cooling. But apparently, the metal can be made to change from crystalline to amorphous through pressure as well. A time constant depending on the material seems to exist in order to change back into the crystalline condition. This constant for structural steel seems to be about ten seconds, and for stainless steel about four minutes. During this period, the metal may be deformed without undue effort, such as might be occasioned by working it in the operator's hands. But upon standing for the required times, it appears to set itself again into a material that requires thousands of inch pounds to alter its shape. The forces required to bring this about are of the order of a half million pounds per square inch compression, which is ordinarily available on a bending machine.

"Setting the Piece to the Die"

Most materials have elasticity or spring back, and if it is desired to bend a piece to a radius of, let us say, three inches, a die of that size will not usually produce a shape of that amount. The finished piece may have a 3¼ in. radius. In order to get a 3 in. radius, the die must be made to a radius of 2¾ in., due to the elasticity of the material. It is well known that this is a function of Young's Modulus. If, now, we superimpose on the stressed material a stress that is normal to the inherent stress, we will wipe out the inherent stress. In some cases, we will also wipe out the impressed stress, particularly if we are able to release same before the above mentioned time limit. Stress relief is a method for accomplishing this fact. Some methods for doing this are as follows:

a. By heat—as in the ordinary stress relief process.
b. By tension—as in the stretch bending process.
c. By compression—as in the process discussed here.
d. By impact—as is used by aircraft manufacturers.
e. By electricity—which is, at this writing, unknown.

Apparently, when the pressure is removed before the above time limit, the inherent stress is removed, but in addition the stress applied to remove it is also removed. This gives a stress relieved condition through a process not associated with heat. This is distinctly something new.

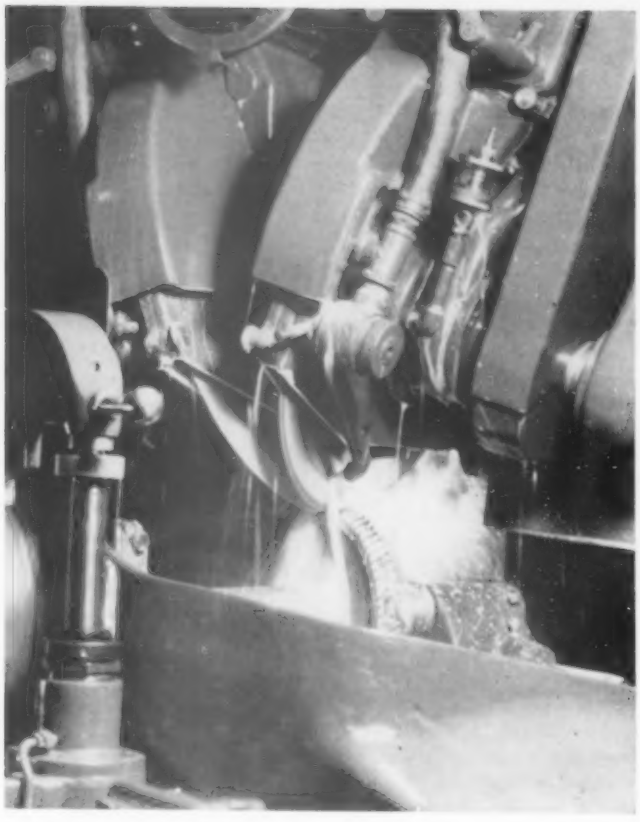
A lot therefore remains to be done before it can be truthfully said that we know anything about cold working metals. At the present time, all we know is that if we do certain things, we get certain results. Until we know why we get those results, we will be operating on empirical rule, which is offensive to a man of engineering training.

Research changes many concepts regarding proper cutting oils

Current Trends in Cutting Fluids

By James McElgin

MANAGER, METAL WORKING DEPARTMENT E. F. HOUGHTON & CO.



THE SCIENCE OF machining metals with the aid of coolants has gone through a variety of progressive ideas in the past thirty years, during which time many of the old traditions have been blasted by new developments.

Concepts have changed in many respects through the years as speeds and feeds increased. There was a time when soda ash added to water to cut down rust dangers was regarded as sufficient to cool the metal being cut.

Then oils were used—often black oils, heavily sulphurized, and unpleasant to the olfactory nerves of the men who had to spend long days in machine shops. When water-soluble oils were perfected, dilutions of such oils served to reduce rusting, and men liked to work with the water dilutions better than with the smelly black oils. However, for deep cuts, there was little progress made by soluble oils up to the time of the recent World War production era, mainly because it had not been discovered how to reinforce such water-soluble oils for heavy duty work.

When new operators were brought in and trained on machine tools the problem of bacteria and skin sores arose again. While this was lessened by teaching operators to take care of their hands, the greatest advance made against dermatitis was by adding germicides to the cutting field, making it antiseptic in nature.

Coolant or Lubricant?

During those years up to 1941 there were many arguments between the two schools of thought as to whether a cutting oil was merely a coolant, or also must function somewhat as a lubricant. The coolant adherents maintained that if the oil was needed for lubrication, it would discourage the cutting function of the tool. The other theory was that the oil lubricated the face of the tool, not the cutting edge, and while oil did not carry off heat as fast as did water, it did cut down friction. Generally it has been agreed that oil, or at least oil content of the fluid, is necessary for both lubrication and prevention of corrosion of freshly machined metal. The problem, however, was how to reinforce a cutting solution with sulphur, extreme-pressure properties and germicides, yet keep the cost down and cooling power high.

One other tradition has changed—the belief in many shops that a different oil must be used for each separate application. That was due largely to the individual operator's preferences. One man had been trained in the use of a light oil, another liked a heavy oil, while still another preferred water-soluble solutions. Under these conditions in the absence of any standards a shop found itself with a sizable and confusing inventory of cutting oils. Much time has been spent by shop superintendents in an effort to reduce varieties and cut down on the resulting possibility of error, as well as the need to have so many sources of supply and storage.

The development of cutting bases which could be variously diluted according to the requirements of the job, helped in this standardization program. The first bases were heavy black sulphurized mixtures, often containing chlorine to afford extreme-pressure values. They were diluted with paraffine oils which the user could buy locally, thus saving freight as well as cutting down on inventories.

For many years this base was popular and even today is sold widely to firms which have used it for thirty years. However, there have been two new concepts in cutting oils in the past eight years. First, there has been a definite trend towards water-soluble coolants, prompted by the desire of the operators to get away from heavy oil coolants. Employers had to keep their workers contented, hence turned to water dilutions wherever possible. The other factor which made this trend practical was the development of bases which were soluble in both water and oil. One such base as supplied today contains sulphur for anti-welding characteristics, a high percentage of saponification, and a germicide, so that it meets all the requirements set forth previously.

Because it may be diluted with water and used at 30 to 1 for almost all cutting operations, one of its strongest points is economy. A cutting fluid at 7 cents a gallon stretches the industrial dollar considerably farther than the old-style oil.

An interesting development of recent months has been the

experiments by users of such a base in putting the water dilution in the lubricating reservoir as well as in the coolant system. We all know certain machine tools are "leakers" and that the ingress of the coolant into the lubricating system is an ever present problem. If the same mixture could be used for both, it would be much simpler, but until recently no one has believed that a water dilution of a soluble oil base could serve as a lubricant.

One case on record has tried such a practice for the past 18 months without harm to the machine tool bearings. Measured on a film strength machine the water dilution was found to carry a heavier load than did most of the lubricants tested against it. This practice will undoubtedly be increasingly tried by machine tool operators and will be watched with interest by the machine tool builders.

One of the pioneers in this movement agrees that not every soluble oil would be practicable for this dual purpose. The oil must be reinforced for film strength characteristics, its sulphur content must not harm bearings, and it must have the ability to prevent rather than encourage corrosion.

Generally speaking, it has been found that the well-made oil base will do all those jobs, but its ability should be carefully examined, for there are many soluble oils of the older type available which do not have these added properties.

The functions of the better cutting fluids, be it water dilution or straight oil, are to carry off the heat generated by the operation, to lubricate the cutting tool, and to flush away the chips from the work. When these functions are properly performed, very definite benefits result.

Greater production is possible due to higher cutting speeds and fewer interruptions for tool changes. There is longer tool life, since cutting edges retain their sharpness for longer periods. There will be increased accuracy in the finished piece, with subsequent decrease in the number of rejects.

Fewer operations will be needed, because of better surface finish obtained on rough cutting operations. Power is conserved, because better tools with some lubrication aid will impose lighter loads. And there is a reduction of work warpage from localized heat because of the cooling properties of the fluid.

The cutting solution itself must have:

High thermal conductivity—recent tendencies are to flood work more copiously, stepping up pump capacities in order to carry away heat resulting from faster speeds.

Ample lubrication to aid in freeing of chips and better finish. Freedom from corrosive tendencies. The more recent developments in coolants have a detergent action, washing away gums and sludges. This also cuts down odor once the machine is clean. The coolant should leave a thin protection oil film on parts which have been machined, to reduce danger of rusting.

Permamence of solution (this refers to the soluble mixtures).

Transparency—making it easy to see the work, as compared to old black oils.

Rapid wetting out. The oil should spread over the work and tool surface fast to permit rapid absorption of heat.

Economical, permitting more dilute solutions and reducing the cost of machining.

Freedom from tendency to foam.

No ill effects on personnel—the coolant should be sterile and free from rancidity. It must not contain volatile materials that might create a fire hazard or be injurious to the health of the operator.

Efforts of various organizations' committees to standardize on cutting oils and reduce varieties were noted a few years ago, and it is recognized that a number of authorities spend a great deal of time on this matter in an honest effort to clarify the situation. Their recommendations represented what was termed "average practice", when normal operating conditions are maintained; the difficulty, of course, was to determine what is "average practice".

Letter to the Editor

Editor:

Our society was wrongly named. The correct name is the American Society of Tool ECONOMISTS! That name is not only correct, it carries with it a distinction and a message not claimable by any other profession supposedly having to do with engineering. No, this is not a joke. Nor is it in any way a condemnation of those who stayed in the rut of conventional thinking when the name we bear was selected.

Examine any or all of the truly engineering professions, Bridge Designers and Architects, Mining Engineers and Dam Builders and all the rest. If you do this you immediately see that all such engineers must mold their designs to fit a project which is of definite physical size, and because this is so, little thought of economy arises until the full measure of the project has been settled by design. You simply cannot put a dam a half mile long across a stream a mile wide, as a crude example. The physical size of the stream when it is coupled with the engineering facts pertaining to dams decides for the engineer the steps to be taken.

We so-called Tool Engineers, if we start our projects rightly, never face a cut-and-dried physical problem. We do not for the simple reason that the product we are to tool up is destined to meet an unmeasured human demand sooner or later. That demand has yet to be measured with the finality with which we swing a tape from bank to bank of a stream or measure such a problem in any more complicated way.

The way we *must* start any tooling job is by asking "How many are wanted?" As a consequence of this "must", those in the selling end of the business supposedly will have settled upon some sort of guess as to how many, before the tooling problem ever reaches the tooling department. If the sales department happens to be feeling optimistic that day, the cost of tooling will be generous and our problem is made easier to solve, since it is far easier to tool for a good quantity than for a limited production. For where the needed volume of production is small, a far greater proportion of the tooling percentage of cost will be spent within the designing room. And it goes without saying that the less appropriated for tooling, the more care we must exercise to meet the tooling budget—and the men we turn these jobs over to, must be those with widest and most practical experience.

All this is Economics! It is not until the economics of such a tooling job have been hammered to size—with someone always retaining a mallet to start pounding again just when everything is good—that the inventive minds get to work to fit the tooling to the project. And when the gentleman who did hang onto his mallet starts swinging, he will not be pounding at some specific design of tool; to the contrary, his efforts will be directed at somebody's estimate of the number of things that can be sold. If he wins his argument, we start all over again and reduce our designs to fit the new production hopes. Every Tool Engineer knows that routine, but how many of them ever stopped to realize that they are operating primarily as Economists, not as Engineers?

This is not as frivolous a matter as it may seem. There is a growing conviction in some quarters that if we realized this possibility of a difference between the two functions we serve, we would do far less fretting and would end up with fewer ulcers—and we would live longer and be happier.

Ethan W. Vars, Chief Engineer
Aldon Products Co., Duncannon, Pa.

By Walter J. Brooking
DEAN, LE TOURNEAU TECHNICAL INSTITUTE

How to Engineer and Coordinate Shop Training Programs

THE TOOL ENGINEER is strategically located to aid in the planning and executing of industrial training, whether it be internal for company upgrading, a company-union apprenticeship, or a company and school cooperative project. In the planning for industrial training either under a company director of training or some other training agency, it is the tool engineer who understands the complexity of the work within the course of training, the sequence of the learner's steps toward his objective, the effect of modern tooling and its relationship to scrapped parts and operator training. He has a broad acquaintance with the shop which allows him to materially aid in organizing training programs, and his knowledge of layout and tooling within the area of training is absolutely essential to the planning of training programs.

The experience gained in the program of LeTourneau Technical Institute is the basis for this analysis. The various problems and factors discussed have been studied in this program in which the student spends half his time working in the LeTourneau Company under the guidance of an instructor and receiving both pay and recognized college credit for his work. The other half day he spends in college classroom study. The most important single element of such a program is the coordination and correlation of shop and school work.

The success and adequacy of the work experience is considered to form the most important single element of an industrial training program. It provides the practical laboratory work in the trainee's field of major interest (corresponding to his major subject in college), and provides the basis and background which is elaborated upon, broadened, and supplemented in an interpretive manner by the formal classroom and school laboratory work. It forms the basic element of differentness and potential excellence of an industry centered or cooperative program as compared to the usual school program of classroom and school laboratory work because of its *practical reality*.

From the Standpoint of the Trainee

The learner's special interest in the initial planning of the work experience in the factory must include the important objective of providing realistic educational experience in his work as a part time employee in the factory in his specific area of interest, such as machining, tool engineering, or whatever else he may have chosen as a major field of interest.

The experience to be gained should include the following:

1. The mastery of the operative skills required of well trained craftsmen in a field of work, such as machining, or arc welding, to a reasonably high degree of proficiency, comparable to the skilled craftsmen in industry having served an apprenticeship or the equivalent in experience.

2. The attaining of maturity of experience for the student in an industrial factory, such maturity consisting of seasoning by experience in an industrial situation. This includes contact with foremen, supervisors, instructors, inspectors, the experience of producing, associating with the other workmen, and the various other aspects of industrial experience.

3. The attaining of an insight by the student into industrial problems of craftsmanship, production, management and supervision, the need for such insight to be awakened and promoted by the educational experience in both the shop and the classroom study of industrial management, human relations, industrial safety, economics, the science of his specialty, and related courses throughout his learning experience.

From the Company's Standpoint

The problem of coordination of a training program with a company's production program involves the primary problem of providing work experience which is progressively educational to trainees, and still be able to be an efficient producing unit. Like other manufacturing concerns the company must be operated at a profit to continue in business.

At the outset it was agreed that in the factory areas where students were placed, all of the training responsibilities would be delegated to the school in close cooperation with the factory supervision. This forms the basis for the undertaking of the cooperative educational program by the institute and the company, the training to be controlled and provided under the supervision of the institute.

ORGANIZATION FOR COOPERATION

Basic Policies and Agreement

The establishment of the policies by which the plan would operate was a problem which was understaken by the dean of the institute (chief of the training program) and the factory manager, subject to the approval of their superiors. The finally approved plan contains the following agreement and understanding:

1. Periodic surveys, preferably at the beginning of fall semesters or summer semesters, and occasionally at the mid-semester, would be conducted by the company to detemine the number of students which would be brought in at any given enrollment time. The institute would assist the factory management in these analyses with such information as probable student mortality based on past experience, and other pertinent information.

2. The school would select and accept students to fill these enrollment quotas, based on the educational and other requirements established by the school, the entrance requirements being established to equal or exceed the requirements of the company for its employees.

3. Upon his acceptance, enrollment, and successful passing of the vestibule training period, the student would enter the LeTourneau Company factory as a part time employee

with pay under the guidance of the institute instructor, and essentially "sponsored" by the institute.

4. The student, while a part-time employee of the LeTourneau Company would be subject to all of the rules and regulations which apply to full-time employees. This was considered to be necessary in the obtaining of realistic education for the student, as well as for consistency of managerial policy on the part of the company.

5. No student could be discharged from the company by the original action of the company management. In such cases as the company foreman or supervision considered it justifiable or desirable that a student be discharged, the dean of the institute, together with the student's instructor and the foreman would study the merits of the case, and on a cooperative basis act as seemed to be appropriate.

6. The shifting of a student from one job to another within a given area would be done at the recommendation of the instructor to the shop foreman, the details of the change and the time of the change to be worked out by mutual cooperative agreement.

7. The student would be shifted from one machine or one type of machine to another after he had reasonably well mastered the work of the machine, as indicated by the judgment of the instructor.

8. The student would not be taken from work within his general area of interest (for example, machine shop work if he were studying to be a machinist) for special assignments to any greater or less degree than the full-time employees in the same area.

9. The student would be given work of actually operating or working on production processes, rather than standing as a helper, and would not be required to do any more floor sweeping, machine wiping, or "flunky" work than was required of the full time employees doing similar work.

10. The duration of the stay of any student on a group of machines within an area (for example, milling machines or turret lathes in a machine shop) would be such that it would allow him, within the first half of two-thirds of his stay in the course of study, to have had experience on all of the major divisions of machines or work available in the factory, after which an effort would be made to allow him to specialize.

Relation of Instructor and Factory Foreman

The instructor in the factory is understood to be an instructor in fact, capable of demonstrating and fully instructing the student in the productive work of the factory. As such, his duties include the spending of all possible time in person-to-person instruction of students in the factory, maintaining records, and planning the grading and evaluating program.

The foreman, in his function of supervising the production within a department for the factory, is responsible for the student's time card and other direct relationships which are company business, treating the student as any other employee in those regards in so far as possible.

The scheduling of various jobs to certain machines in a machine shop are part of the company's and the foreman's function, and the methods of tooling and production procedures as established by the company's methods and tool engineers are the methods taught by the instructor.

In all cases where the instructor might wish to make suggestions as to method, he and the foreman discuss the matter, and in cases of differences of opinion, the methods and tool engineers for the company make the final decision as to the method or the procedure.

Student and Full Time Factory Workman

The student has the benefit of the institute instructor's teaching when he encounters problems in the course of his work; whereas the full time employee is supposed to be already fully trained, and obtains such assistance or answers to questions as he needs from his departmental foreman. The general theory is that a student should produce unit for unit equal to full time workmen per unit of time while he is producing, but that part of his time should be spent in receiving instruction which may reasonably be expected to reduce his overall production compared to full time employees for the same number of hours.

ANALYSIS OF FACTORY FACILITIES FOR TRAINING

At the outset, an analysis was made of the factory facilities for training, to determine what areas in the factory would provide work experience or students in sufficient numbers to allow a course of instruction. Some examples follow:

In the LeTourneau Company's factory the machining program included between six hundred and seven hundred machine tools, some standard lathes, drills, gear cutting machines, grinders and milling machines, and numerous special semi-automatic lathes built by the company, together with over twenty special jig boring mills, planers, shapers, boring mills, and other special machines used in building production machine tools or manufacturing jigs and fixtures.

There were approximately three hundred and fifty welding machines in the factory, most of them transformer type a-c welders. About twenty were d-c motor-generator type machines, including about four different models. The work in the welding department was organized about the jigs and fixtures which produce the welded parts for the building of large, completely arc-welded earth moving machines and steel forms for concrete house building.

The facilities for heat treating and metallurgical processing and control included carburizing furnaces, flame hardening units, liquid heating furnaces, draw furnaces, special quenching tanks and fixtures, normalizing or heat treating furnaces, production metallurgical testing equipment, forging furnaces, and a complete metallurgical testing and control laboratory.

ESTABLISHING THE PLAN OF TRAINING SEQUENCE IN THE FACTORY

After surveying the facilities available for student training in each of the major course objectives, a more detailed plan of the students' experience in the shop was made. A scale layout which showed the location of every machine in the plant was utilized as a basis for a classification of students' work stations.

Analysis of Work Stations

The analysis of work stations for students in the factory includes five general steps.

1. List the work stations available for cooperative educational training in the factory.

2. Classify the type of work done at each work station (examples: drilling, milling, lathe work in a machine shop) as well as its complexity.

The complexity analysis is based upon the amount of experience a student must have had to accomplish the work at that station.

3. Determine the relative length of time the *average* student must remain on that station to obtain the maximum educational value from the station. This depends upon the variety of jobs done at that station or machine over a given period, the complexity of the jobs and the probable variations in materials, production requirements and others.

4. Outline the general sequence of work stations for the students, starting from the most simple work stations and progressing to the complex ones requiring skill and previous knowledge. The stations between these two extremes should be planned to follow in a logical sequence, but not in an unvarying sequence for different students.

SHOP AND LABORATORY RATING SHEET

Directions for use: Rate the student as accurately as possible on each factor listed below: Ratings: A-Excellent; B-Good; C-Fair; D-Pass; F-Failure.

NAME _____ BADGE NO. _____ COURSE _____

	A	B	C	D	F
QUANTITY OF WORK	Completes large amount of work	Completes more than average	Completes work in reasonable time	Very slow	Unsatisfactory
QUALITY OF WORK	Very high quality of work	Accuracy above average	Works without undue errors	Accuracy below standard	Unsatisfactory
TRADE KNOWLEDGE	Excellent on his and knows related jobs in trade	Understands own and related jobs	Knowns own job well	Fair grasp of own job	Does not understand own job
ABILITY TO LEARN	Excellent	Above average	Average rate of adaptation	Learns slowly	Unable to learn
JUDGEMENT	Excellent	Unusually good	Moderately good	Some tendency to react impulsively	Notably lacking
DEPENDABILITY	Completely	Very dependable	Responsible, but needs average direction	Needs considerable direction	Needs constant direction
ATTENDANCE	Always on the job	Rarely absent	Absent only for good reasons	Frequently	Takes time out at every opportunity
COOPERATION	Cooperates and inspires	Fits easily into the group	Usually cooperates willingly	Gives limited cooperation	Fails to cooperate

Comments: _____

Date _____

GRADE _____

Signed _____
Instructor

5. Plan the relative amount of time a student should stay on each station. Three important factors are considered in establishing the ideal time for a student on a given station:
   a. The length of time required to master the work on that station, keeping in mind the variety of jobs which are done there, the complexity of the procedures.
   b. The mechanics of the learning process. It is recognized that it is almost second nature for young energetic students to feel that they have mastered a process when they have repeated it a few times; but that in the mastery of a learning process involving both mental and physical conditioning, the learning proceeds rapidly during the first few hours or days and the rise to acceptable standards of industrial proficiency depends upon practice, observation, and interpretation of minor variables that occur on a given work station over a period of time. The maturing progresses less and less rapidly with each passing unit of time; but in general, the maturity and proficiency increase toward complete mastery.
   c. The relative amount of work done on that or similar training stations, and the importance of the training on that station to over-all training toward the final objective should conform to a preplanned yet flexible pattern.

Example of Training Plan

The following plan for machinist students shows the general outline of experience and length of time desired, based on past experience. The outline presents the minimum number of hours of work for the average student on each type of machine or type of work in the shop under normal conditions. It also presents the average number of hours on each for a student who does not specialize in any field. These total 3600 hours, or all the time normally available in the course.

Normally it is expected that students will specialize in one or more fields. To this extent, the total number of hours less than the average they work in some fields is added to the average in the fields in which they specialize. Additional hours over 25 per week will normally apply toward a student's specialization interests.

Machines or types of work	Normal Minimum Hrs.	Average Hrs.
Drills		
Milling Machines & Special Mills	250	400
Planers and/or Shapers	150	350
Engine Lathes	25	50
Turret Lathes, Tournamatics and Automatic Lathes	600	800
Tool Grinding	200	300
Production Grinding (External, Internal and Surface)	250	350
Gears Shapers, Hobs & Generators	250	400
Bench Work and Assembly	25	150

RECORDS AND EVALUATION OF STUDENT'S WORK

The recording of the student's work and the evaluation of his work as he proceeds toward his objective is an important part of the organization of the shop work experience.

In addition to a record of experience in the shop, an evaluation of the work which the student does is made each month by both instructor and foreman. The grade sheet used is shown above, four monthly separate ones being filled out independently by both instructor and foreman.

Because of the alternation of work in the factory and formal school study in the classrooms every half day, the students are not expected to maintain notebooks on the factory work, but rather to bring the problems which they have encountered into the classroom, as a means of actively coordinating factory and classroom experience.

PROBLEMS AND THEIR SOLUTION IN WORKING THE PLAN

Transfer of Students

The problem of determining when a student should be transferred from type of work to one more advanced in the

same area has not been difficult in most instances, as far as the instructor and the foremen are concerned.

Generally it has been found inadvisable to set a definite period for a student on one type of work. The need for a student to stay on a machine until he acquires skill in the operation of a machine or is doing a given job on that machine is indicated by most studies of motor learning.

The solution to such problems raised by students has been accomplished by explaining and demonstrating to him that repetitive practice is the only way in which skill may be acquired.

Discipline Problems

Such problems as students leaving their machines early to wash up before the quitting hour arrives, tardiness, leaving the department, excessive visiting on the job, and other problems have been essentially the same as for the full time employees; and the solution of such problems is the same: that of holding personal conference with the student and giving him opportunity to demonstrate his willingness to cooperate.

Failure to cooperate is looked upon by both the institute and the company as an indication of need for guidance and counsel. Flagrant cases of non-cooperativeness cause a serious problem of morale in an industrial factory, and in case of consistent and persistent failure to cooperate, the student is subject to dismissal by the institute within the rules of both the institute and the company. Only one such case has been encountered since the school began its program.

Grading Student Shop Work

The grades given by shop instructors early in the program tended strongly toward average grades, with few grades indicating excellence and almost no failures. This was looked upon as a major problem and its solution was undertaken by discussing it in staff meetings and individually with the shop instructors. The unfairness to a student who is failing and not being marked with failure was pointed out to instructors. It was also pointed out that it was unfair not to give appropriate grade recognition to the student whose excellence was evident to both the students and his associates.

After a few months on the job, the instructors begin to differentiate and to grade more nearly in keeping with the normal expectation. The grading sheet shown in Fig. 1 is a check sheet which helps the instructors to think in terms of evaluation of several characteristics, and has proven helpful in their learning to grade with discrimination.

This tendency was also noticed on the part of the foremen, who evaluate students' work once a month as a matter of raises in rates of students' pay. The best approach to the foremen was to encourage them to make comparisons of their grading and grading principles with those of the instructors in their area of the factory.

Rate of Pay for Students

The starting rate was established for students by the company after careful consideration to correspond to trainee rates within the area. This was raised 20 percent soon after the program started due to the unexpectedly good response of students to the instruction.

It early became evident that as a student became more proficient, his rate of pay should increase; and if he did not meet the average of his fellow students' progress, he should be dropped from the program when it was demonstrated that he was consistantly failing.

A system was therefore worked out by the dean of the institute and the factory manager, whereby at the end of three months, the students' grades, as shown by both the shop instructor and the foreman and *all of the students' classroom instructors* are taken into consideration. If they average above a failing grade, the student is given a five cent per hour raise. Should he fail at the end of the first three months, his rate is again reviewed at the end of the fourth, fifth, and sixth months and should he not have been eligible for a raise at the end of the first six months, he is dismissed from the course.

Both the company and the institute felt that his grades in the classroom, as well as those in the shop should determine the basis for the rate of raise in pay. Over ninety-five percent of the students qualify for their raises at the end of each three months.

This plan has proven satisfactory to both students and the company. It provides a rather rapid rate of increase (twenty cents per hour in twelve months) when compared to the usual raises in pay earned by full time workmen in comparable industrial employment.

Constructive criticism and suggestions as to methods and other pertinent subjects are normally channelled to the proper administrative authorities through the instructor or the foreman, whomever the student feels he wants to contact first. Normally, it is considered that he should talk it over with the instructor, and with his guidance present it to the foreman if it is within the foreman's realm to make a decision or obtain decision on the matter from higher authorities. This channel has been effective for most student suggestions and criticisms.

CORRELATION OF WORK AND CLASSROOM STUDY

Ideally, the work which a student does in the factory should be discussed and supplemented by parallel study in the classroom subjects and school laboratory subjects daily. The achievement of this ideal has been found to be very difficult; and, considering the broad aims and breadth of field which the student's objective encompasses, it is considered by the institute that such close coordination is neither practical nor really necessary.

The most important correlation in the institute's plan is that of providing the elementary theory of the shop major subject in a classroom or a classroom and laboratory combined (for example, theory of welding or theory of machining) concurrently with the students' early work in the factory. For the first semester, or the first year, these theory courses specifically supplement the work done in the shop, and provide the most important supplementary and correlatory studies.

Correlation of the classroom work in the subject of general education and elementary science is accomplished by questions raised by students in the classroom, and the slanting of subject matter and presentation by the instructor toward the interest of the student. The theory of the approach to curriculum is to provide the correlated and general elementary theory of the subject when the student begins his course, and, as early as possible, to give him the basic general scientific subjects such as mathematics, mechanical drawing, physics and chemistry; then to provide him with the more highly specific technical, scientific, and near-engineering studies of his general field after he has had sufficient experience to be able to interpret them in the light of industrial practice.

It has been the experience at the institute that it takes about a year for a student to become a reasonably proficient operator in his chosen field, at which time he begins to comprehend a need for further and deeper study and has, therefore, developed to the stage where the more specific study is pertinent.

The Function of Interchangeability in Tool Engineering

By G. H. Stimson

GREENFIELD TAP AND DIE CORP.

INTERCHANGEABILITY OF THE components of an assembly constitutes the basis upon which the principle of mass production is founded. The ability to interchange or replace like components without resorting to selection is dependent upon intelligent application of tolerances to dimensions by the designer and accurate control of the dimensions within tolerance during production.

Far too few designers realize that the task of assigning tolerances to dimensions is perhaps just as important as originating the design. The final cost of the product is closely related to the degree of accuracy established for the dimensions by the engineer when assigning tolerances.

The extent to which the components of a product are made interchangeable is dependent on many factors. The engineer should have available accurate detailed knowledge of all phases of the product before attempting to tolerance the dimensions. In addition, he should make a careful study of the end use of the product to determine what it is to accomplish.

Importance of Tooling

The correct design of jigs, fixtures, dies, molds, tools and gages plays an important role in permitting fully interchangeable production. The jig and fixture designer must choose the proper surface of the part from which to start processing, if the part dimensions are to be in proper relation. Safety, ease and rapidity of loading and effectiveness of locking devices are matters for careful consideration.

Among the most expensive tooling items are casting dies, plastic molds, punch and die assemblies, and metal patterns. The tool engineer can save many dollars in the cost of these items if the dimensional tolerances are not closer than required to provide reasonable wear on the tools and produce a satisfactory product.

Designers may thoughtlessly locate holes which must be drilled, reamed or tapped in nearly inaccessible places. This practice will cause the tool engineer to order special length tools which may cost many times more than a regular size.

Since regular stock taps and dies are designed to apply to general use, a particular application may require that the tools be modified to suit the material being threaded. Thus the supplier should be given all necessary information to insure that the tool will produce to the desired tolerance and provide satisfactory tool life. The chamfered threads of taps and dies are in reality multiple single point tools. Unfortunately the feed cannot be varied as would be the case with a lathe and planer tools or drills, since the feed in tapping is dependent on the pitch of the thread. In order that the depth of cut be consistent with good practice, the amount removed by each tooth is regulated by the combination of the number of teeth chamfered and the number of lands. These may be varied only within limits controlled by the amount of clearance allowed in the bottom of the tapped hole, and good flute design. Bottoming and blindholes curtail the amount of chamfered teeth on the tap. Fig. 1 illustrates four chamfered teeth of one land of a four land tap. Applied to a 20 pitch thread tap drilled for 75 percent thread depth the total depth of cut (16 teeth) would be 0.0244 in. Each cutting tooth would then remove 0.0015 depth of cut. The same tap with one thread chamfer would require each tooth to remove 0.0060 in. The same bottoming tap made with six lands would require each tooth in the chamfer to remove 0.004 depth of cut. Increasing the number of lands decreases the chip space in the flutes and also may impair correct design of the flute. When the depth of cut per tooth is too great and cannot be reduced by increasing the number of chamfered teeth or number of lands, it will be necessary to use a serial of taps. Sets of taps for this purpose are divided into two groups. Taper, plug and bottoming taps are made with the same pitch diameter size but with a varying number of chamfered teeth: the taper tap usually has 10 chamfered teeth, the plug tap 4, and the bottoming tap 1½. The cutting action of a tap is to remove material progressively with the outside of diameter of each tooth and for a short distance down its sidewall and face. Taper, plug and bottoming taps will, when used successively in the above order, remove material at a decreased rate per tooth. To simplify explanation of the cutting action, the three taps are likened to three taper reamers each with an increased taper.

In Fig. 2 the cross hatched area T represents the material removed in one side of the hole by the taper tap. The shaded area P would be removed by the plug tap, and the dotted area B would be removed by the bottoming tap. When the hole is a deep one it may not be possible to employ taper, plug and bottoming taps to decrease the depth of cut per tooth, because too many chamfered teeth on the taper tap would be cutting at one time. The torque necessary to turn the tap and overcome the resistance to cutting may be excessive enough to cause tap breakage. When this occurs serial taps should be used.

Serial taps differ from taper, plug and bottoming taps in that each tap is made with a progressively larger pitch diameter. This permits shortening the number of chamfer teeth, since each tooth in the chamfer is not required to remove as great an area, or as much depth of cut. Fig. 3 illustrates this.

The two sketches in Fig. 4 compare the clearance angles of a turning tool and a tap land. The angles d and c of both

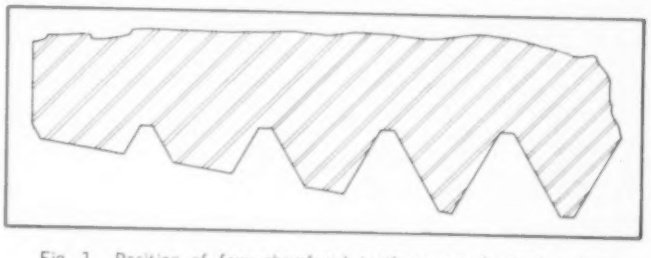


Fig. 1. Position of four chamfered teeth on one land of a four land tap.

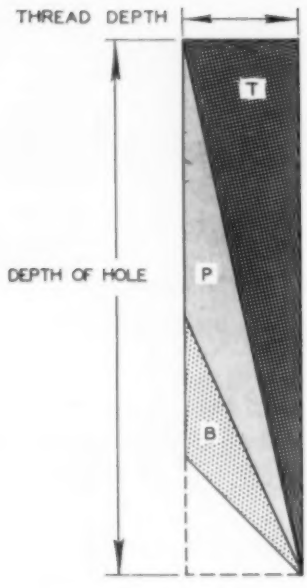


Fig. 2 (above) illustrates cutting action of taper tap (T), plug tap (P) and bottoming tap (B).

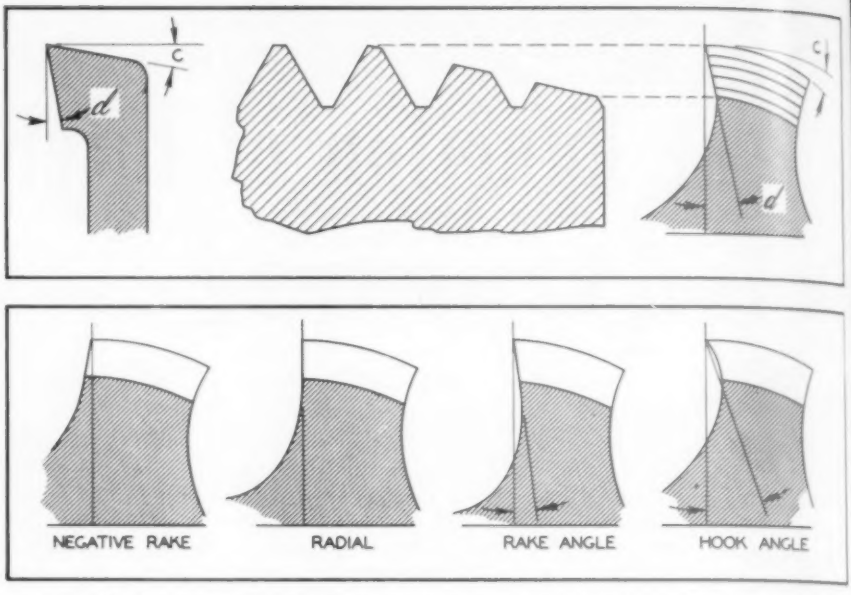


Fig. 4 (top) shows a comparison of the clearance angles of a turning tool and a tap land, where angles D and C of both are varied to meet needs; front clearance angle C of turning tool and relief on OD of tap teeth are similar; and top rake angle D on turning tool is equal to rake angle of face of chamfered teeth on tap. Fig. 5 (bottom) illustrates correct terminology of various designs of rakes on taps.

tools are varied to suit the material to be cut. The front clearance angle *c* of the turning tool is similar to the relief on the OD of the chamfered teeth of the tap. The top rake angle *d* is equivalent to rake angle of the face of the chamfered teeth on the tap.

Taps designed for cutting cast iron and yellow brass are made with a 0 deg rake angle, while taps for cutting aluminum may have a rake angle of 20 deg. The rake angle is also modified to get best results with other materials: some materials are best cut with taps having flutes with radius form. The rake of such taps is measured along the cord of an arc which would pass through the OD and minor diameter of the tap thread. Fig. 5 shows the correct terminology.

Tap Design

The product designer who limits bottoming and blind tapped holes to a minimum will ease tapping problems and save considerable expense. The tool engineer who is careful to specify the material which is to be tapped will receive tools properly modified for best results and longer tap life.

Correct use of taps and dies will also materially add to their wear life. Misalignment between the axis of the taps and the axis of the tap drill hole in the product is a common cause of tap breakage, and may cause the tap to produce a bell-mouthed hole. When resharpening the chamfered teeth of taps care should be taken to preserve the same number of cutting teeth as originally provided on the tap. If the point diameter of the first effective cutting teeth is much smaller than the tap drill hole, the effect will be the same as shortening the chamfer which in turn will increase the cut per tooth and may cause breakage. Uneven chamfer grinding will result in the highest land performing all the work of cutting, and increase the depth of cut per tooth. The ideal chamfer grind is to have the tap point enter the hole about one-half pitch before cutting starts.

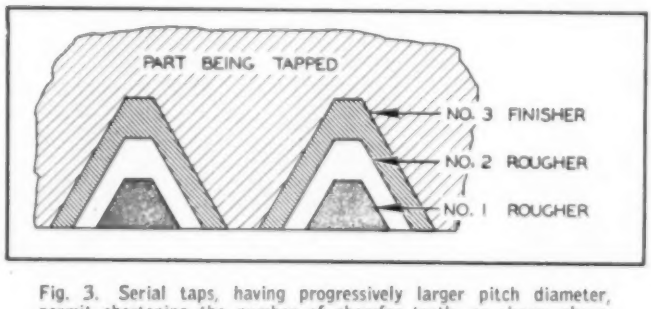


Fig. 3. Serial taps, having progressively larger pitch diameter, permit shortening the number of chamfer teeth, as shown above.

The form of the tap flute was designed to fulfill a definite purpose. When the contour is changed by regrinding in the flute the tap will not perform as efficiently as it should. With the exception of taper thread taps the flute should not be reground except to adapt it for another purpose or to correct a damaged condition.

Gaging Practice and Interchangeability

Early in the era of interchangeable mass production product limits were controlled almost wholly by measurement. Devices used to accomplish this purpose include the ordinary machinist's scale, micrometer and vernier calipers. When properly used the micrometer and vernier caliper will measure to close limits, although considerable skill is needed to make accurate close measurement.

To facilitate mass production of large quantities of parts which are to be identical within allowable errors, it is essential that some rapid and positive means of checking the dimensions be employed. Fixed gaging methods are the answer to this problem. There is a basic difference between the use of measuring instruments and fixed gages: measuring instruments determine the actual dimension, while the function of the fixed gage is to ascertain if the actual dimension of the product is within the maximum and minimum limits allowed. Go gages check the tightest metal-to-metal fit between the mating components. They are termed the critical gages because they control whether mating product will be interchangeable. Not Go gages control the loosest fit between the mating components. They are essential because they check the extreme limits of the product.

Fixed gages, like any other product, must be made to toleranced dimensions, and the direction and amplitude of the tolerance has a direct effect on their gaging efficiency. Standard basic procedure has been established to govern the application of gage tolerances.

The relationship of gage tolerance to the product tolerance is shown in Fig. 6. The diagram illustrates the unilateral system of applying product tolerances, and identifies the terms tolerance, limit and allowance. The specification from which the diagram is derived calls for a hole diameter of 1.000

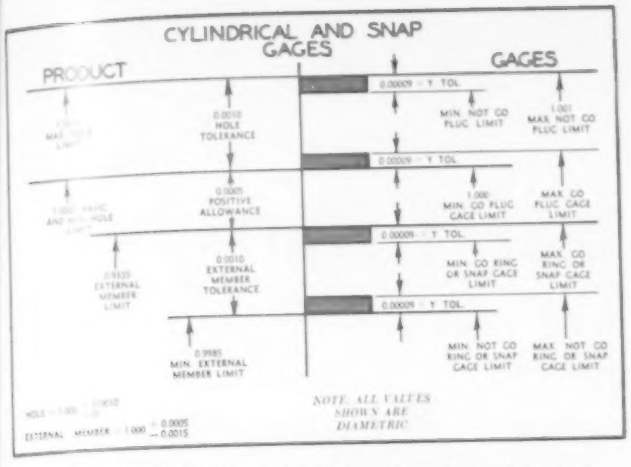

CYLINDRICAL AND SNAP GAGES
PRODUCT
GAGES
0.0010 HOLE TOLERANCE
0.0005 POSITIVE ALLOWANCE
0.0010 EXTERNAL MEMBER TOLERANCE
0.9985 MIN. EXTERNAL MEMBER LIMIT
0.00009 = Y TOL.
MIN. NOT GO PLUG LIMIT
1.001 MAX. NOT GO PLUG LIMIT
1.000 MIN. GO PLUG GAGE LIMIT
MAX. GO PLUG GAGE LIMIT
MIN. GO RING OR SNAP GAGE LIMIT
MAX. GO RING OR SNAP GAGE LIMIT
MIN. NOT GO RING OR SNAP GAGE LIMIT
MAX. NOT GO RING OR SNAP GAGE LIMIT
NOTE: ALL VALUES SHOWN ARE DIAMETRIC

Fig. 6. Relation between product tolerances and gage tolerances.

GAGE MAKERS' CYLINDRICAL GAGE TOLERANCES

RANGE ABOVE	RANGE To And Inclusive	Class XX	Class X	Class Y	Class Z
.029	.825	.00002	.00004	00007	.00010
.826	1.510	.00003	.00006	.00009	.00012
1.511	2.510	.00004	.00008	.00012	.00016
2.511	4.510	.00005	.00010	.00015	.00020
4.511	6.510	.000065	.00013	.00019	.00025
6.511	9.010	.00008	.00016	.00024	.00032
9.011	12.010	.00010	.00020	.00030	.00040

$+0.001$ and an external member diameter of $1.000\ {}^{-0.0005}_{-0.0015}$, $^{-0.000}$. The heavy central horizontal line represents the basic size of 1.000.

The hole limit values are secured by applying the hole tolerance to the basic dimension. The hole limits are then 1.000 minimum and 1.001 maximum. Applying the external member tolerance of -0.0005 to the basic dimension, the -0.0015 resultant limits would be 0.9995 maximum and 0.9985 minimum. The separation between the minimum hole limit and the maximum external member limit is the allowance to permit freedom of fit.

Gage tolerances and limits are shown in relation to the product tolerances and limits at the right of the heavy vertical line. So that gage tolerances will not extend the product tolerance they are applied inside of the product limits.

Working and inspection gages which are made to the same limits may sometimes cause conflict between the production and inspection departments in accepting and rejecting the product, if the inspection Go plug gage size is made near the high limit. When this condition is critical it can be corrected by providing Go working plug gages which are made intentionally larger than the inspection gages. This must be done with the complete understanding of the production department, as the practice will in effect curtail the allowed product tolerance. Extra wear life may be provided on Go plug gages by the same procedure where undue wear is encountered in gaging abrasive materials.

The features of a gage which most affect its efficiency in checking the product are its accuracy and wear life. It is far better not to use gages than to use inaccurate ones. To illustrate the foregoing consider a Go and Not Go plain plug gage for use in checking a 0.500 plain reamed hole with a 0.0010 tolerance. If a tolerance of 0.0002 is allowed on the size of the gages, the Go gage can conceivably be 0.0002 larger than the limit of the minimum hole. If the Not Go gage is made to its minimum limit it will be 0.0002 smaller than the maximum hole limit. This in effect has reduced the product tolerance of 0.001 to 0.0006 and the assigned product-product tolerance has been decreased 40 percent. If the gages had been made to a standard *Y* gagemakers' tolerance the product production tolerance would at the extreme have been reduced only 14 percent.

Wear life of a gage is concerned with the degree of surface finish and the material from which the gage is made. In comparing two identical gages, one of which is ground only, and the other ground and lapped, the lapped gage will far outwear the former. The lapped gage will have a higher degree of surface finish and an increased contact area with the work, which will provide for increased wear life.

It may appear that the harder the material from which a gage is made that the longer its wear life would be. This is not necessarily so, since extremely hard materials have the disadvantage of being brittle. The application of chromium to the contact surface of gages will increase their wear life through combining the low coefficient of friction of a chromed surface with its relative hardness. The decision as to when to use gages made from long wearing materials is an economic one and should be based on the number of inspections desired and the care given the gages.

Plain cylindrical gagemakers' tolerances are shown at the bottom of Fig. 6. There are four classes which vary by size, range and accuracy. It is customary practice to select from these four the gage tolerance which is equivalent to 1/10 or less of the product tolerance. In the diagram the product tolerance is 0.0010. From the foregoing the gage tolerance should be 0.0001 or less. Class *Z* gage tolerance for this size of gage would be 0.00012, which is larger than 0.0001. The correct gage tolerance to use would therefore be *Y* or 0.00009.

Thread Gages

The function of thread gages in checking screw threads is somewhat more complicated than that of plain cylindrical gages. As previously explained there are three principal elements of a screw thread, each of which may have errors which will seriously affect interchangeability. All of the product errors of lead, angle and pitch diameter must be contained within the allowed effective pitch diameter tolerance. A serious lead error could consume all or more of this effective pitch diameter tolerance.

Go plug and ring thread gages merely establish that the components will be interchangeable. Each may fit their Go gage snugly and still the effective tolerance may be exceeded. If a serious lead error is present in a tapped hole the Go plug thread gage will not enter for the full length of engagement until the actual pitch diameter of the hole is sufficiently larger than that of the plug thread gage to compensate for the diametrical equivalent of the lead error.

Not Go thread gages are essential to make certain that the accumulation of thread errors due to lead and angle have not extended the product tolerance beyond its limit. Not Go thread gages which do not enter or are not entered by the product point out that the product pitch diameter tolerance has not been exceeded by excessive lead error. The Not Go gage checks the actual pitch diameter only, and if the actual pitch diameter of the product had been made oversize beyond the tolerance to compensate for excessive lead error, the Not Go gage would engage the product.

Thread angle error is checked by Not Go gages by truncating the crest and root of thread too near the pitch diameter. If serious angle error were present the product would be engaged and rejected.

Thread gage manufacturing tolerances are applied in the same manner as cylindrical gage tolerances are applied. There are three recognized tolerances used, *W*, *X* and *Y*. Tolerances *W* and *X* vary by accuracy; *W* being approximately one-half of *X* in all elements of lead, angle and pitch diameter. The *Y* tolerance has generally the same value as *X* but is applied so that its minimum limit is larger than the minimum limit of *X* tolerance. It is used as a working gage tolerance to stop conflict between work and inspection gages and also to provide extra wear.

By John A. Markstrum
APEX BROACH CO.

Design of Broaching Fixtures

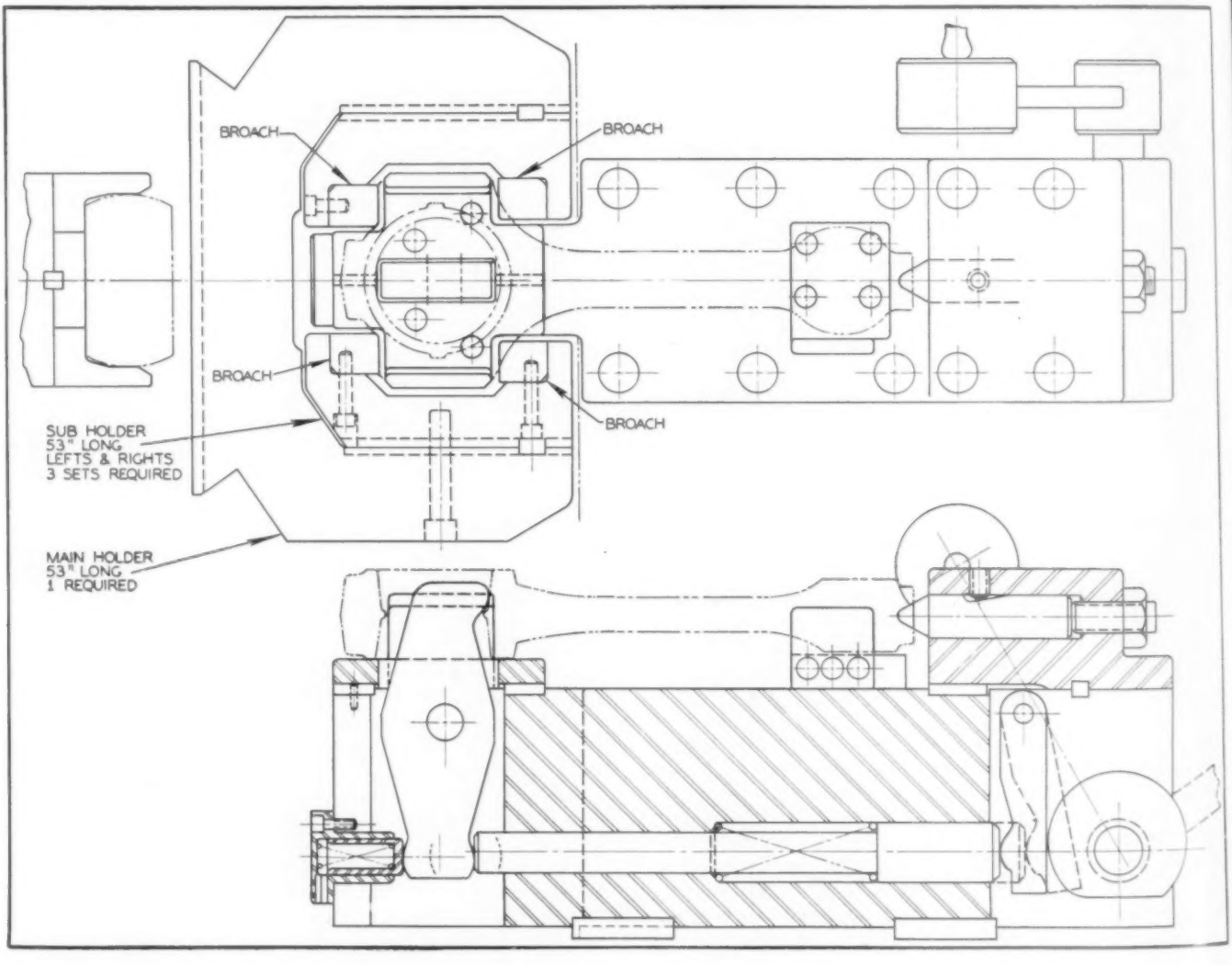
BROACHING FIXTURES require greater ingenuity in design than do fixtures for most other types of machining. A greater number of parts pass through broaching fixtures, due to rapid machining, than in other stock removing applications. Therefore, ease of operation must be considered to reduce the fatigue of the operator. Rapid application of tons of broach pressures means that the fixtures must be free from flex and that the part must be well anchored.

The qualities desired of broaching fixtures include: Ease of loading. Accurate and solid nesting of the part. Unrelenting, strong and speedy clamping. Replaceable wear anvils in nest and clamp. Work supporting jacks where necessary. Adjustment for alignment of work in relation to the broaches. Convenience for the operator. Ready elimination of chips and above all simplicity of design that will stand the rigors of continued use.

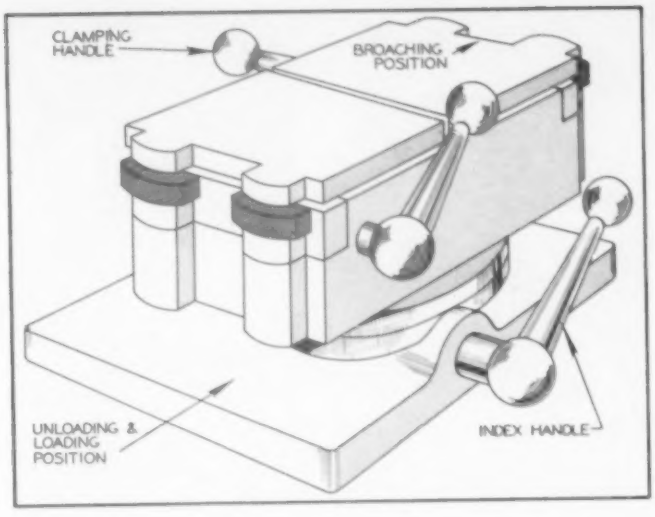
In meeting the various requirements it is generally found that simplicity is the most difficult quality to attain. This is not only peculiar to broach fixtures, but applies to all engineering. The more direct movements and forces are applied, the more durable and practical is the device. In broaching, rugged simplicity is a must, if good results are to be expected.

Some broaching applications are the first operation on rough forgings or castings. In these installations the part must be supported and located to best advantage according to its nature. Bedding spots should be as far from the parting flash as practical to avoid undue variances. In many cases it is necessary to employ compensating members to equalize the position relative to the cut.

Parts subject to bending by broach forces, either in the longitudinal or transverse direction or both, must be supported by jacks in the direction or directions required. Such jacks may be manual or automatic depending on the amount



Double end rotary surface broaching fixture for use in vertical machine. Parts are loaded into station facing operator, then fixture is swiveled into cutting position, while finished parts are brought into position for unloading.



of parts to be produced. Thin parts, with resting surface finished, may require a four-point equalizing clamp to lock evenly, and prevent movement of the part during the operation.

First operation installations require more study in nesting coupled with heavier clamping due to the difficulty of holding the part firmly, since any movement of the part, especially rolling, usually results in breakage of the broaches. Frequently in such instances the broaches are unjustly condemned as being improperly constructed. In some cases a change in design of the broaches may overcome this condition, although the best method is to secure the part against movement in the fixture.

Fixtures for parts that are located from rough surfaces should have means for adjusting the position relative to the broaches—in and out and sidewise. While this is a good feature for any type of surface broaching, size variation in rough stock makes such adjustment imperative. Wedges should be used for this purpose to insure permanence, as well as to prevent angular misalignment of the fixture in relation with the broaches, when adjustments are being made.

Indexing for broaching may be either rectilinear or rotary. In some instances the part is locked in place and remains locked while moved from station to station until all cuts are completed. Meanwhile the part-holding member of the fixture is moved from notch to notch and secured with a pawl. In other applications it may be advantageous, sometimes even necessary, to index the part alone. Wherever there is danger of broaches interfering with the fixture in incomplete indexed position, microswitches should be employed to immobilize the ram until indexing is complete.

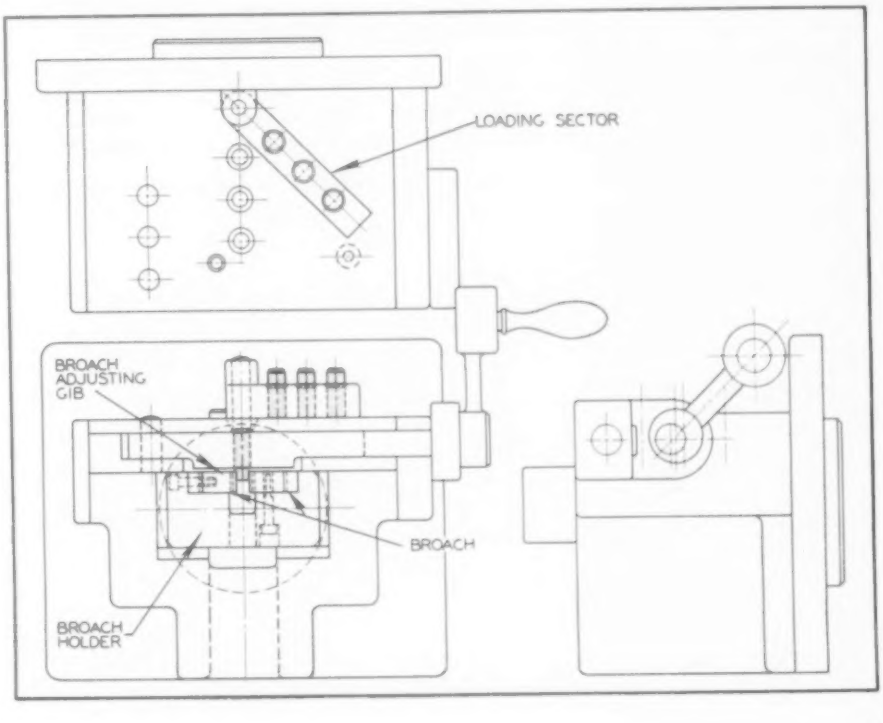
Large internal gears are broached, several teeth at a time, and indexed in the proper ratio between each cut until completed. Chain sprockets are finished in a similar manner. Large external gears are also rough broached, one or more teeth at a time. All of these are usually locked in place and spaced with a self-contained index in the fixture in order to prevent accumulated errors in spacing.

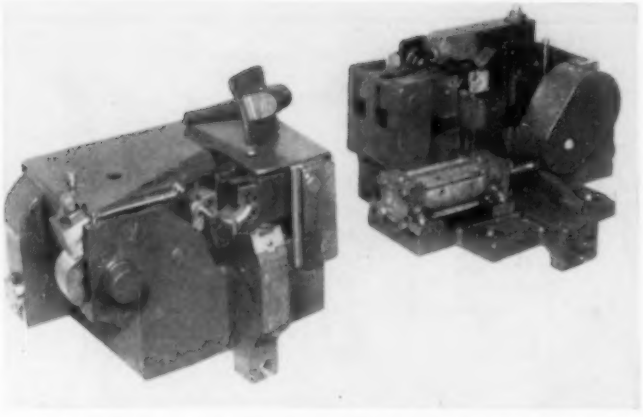
Internal splines, in sizes so large as to make a solid broach impractical, are cut with a keyway broach, one spline at a time. In this case the part itself is indexed around the central stud, or broach supporting horn, which in turn is equipped with as many slots as there are splines. After the first spline slot is cut this spline is rotated to the first index slot in the horn and a key is inserted to properly space the part for the second cut. Indexing for the remaining cuts should always be from the first spline in the part in order to maintain accuracy of spacing.

Rectilinear indexing is encountered in parts on the order of a rack. As racks are commonly of considerable length it is expedient to move the part only between the cuts. In moderate sizes a considerable number of teeth may be cut at

At left is an illustration of broach tooling for use in the machining of the bolt head and nut seats on a connecting rod and cap forging. The cap and rod are separated after this operation. This fixture and tooling setup was designed for installation on a vertical surface broaching machine incorporating a receding table. Operational sequence is as follows: the small end of the rod is first located on a center, then the large end is centered on the previously broached convex bosses, while a single clamp locks the rod in the forged hole.

In this application, two flats are broached on three rods at one time in a horizontal pull broaching machine. The parts are first placed in a loading vector during the cutting stroke of the machine. At the end of the cut, the clamp shown is released and the parts fall into an oil pan. After the broaches return, the vector is swung into the loading position, the parts drop into the fixture, then are clamped and ready for the cut.





Hydraulically-operated fixture for straddle broaching the king pin boss of an automobile steering spindle. This is the first operation from the rough forging. The stem is centered on two individually balanced compensating V-blocks which recede under the clamping action until the part comes to rest on stationary anvils at each end, correctly positioned in all directions. At left is the side of the fixture nearest the broaches. Front to back are the double rest anvil for the bosses; endwise positioning anvil; the two sets of V-blocks, with rear stationary anvil hidden by clamp shown in open position. Developed clamp visible at left. At right, with the cover removed, is the operator's side, with the part in place, and clamp in locked position. V-block which compensates for size variation in the forging and stationary anvil is shown holding the small end of the part. Hydraulic cylinder and actuating rack are visible.

a time, while the index pawl may engage the teeth previously broached each time the part is advanced to a new cutting position. In this way very accurate spacing is assured. With a fast-acting clamp this method is highly productive. Rack-shaped parts of suitable proportions may also be broached in more than one cut with a single clamping.

Heavy parts produced in considerable volume which require a multiplicity of holes or slots, may be easily manipulated if locked to a free acting carriage equipped with suitable indexing stations. Smaller parts with squares, cross slots, diamond serrations and the like may be broached with a single clamping to great advantage by indexing between the cuts.

Another form of indexing fixture rotates for the express purpose of presenting the loading station at a convenient position for the operator to exchange the parts. One or more parts are loaded in a station facing the operator while the parts in the opposite station are being broached. Aside from convenience there is also a saving in loading time. Parts of suitable form may be automatically ejected while indexing the loaded side into cutting position.

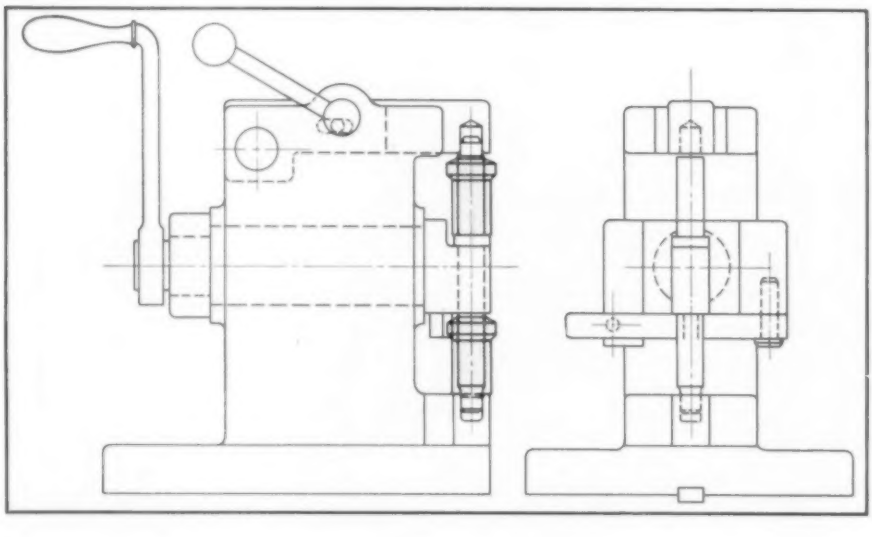
Horizontal pull broaching machines and certain vertical machines, not equipped with receding tables to clear work and broaches on the return stroke, require that the fixture

This fixture with indexing broach supporting horn is used in the cutting of a large internal spline in a bevel gear with a long hub. The adjustable concave rest anvil visible at the left supports the overhang of the heavy part. The bracket is removed to make the fixture suitable for broaching various other disc-shaped parts. Indexing is obtained by key fitting the first slot broached, progressively matched to the accurately spaced holes in the horn.

be equipped with this feature for surface broaching. It is further necessary to install such a device to make loading possible and in addition loading may proceed while the broaches are being returned.

Commonly a swinging, hinge type, work-holding member known as a clapper head is employed. This clapper is swung 90 deg to clear the work away from the broaches during their return, and also to bring the work into a convenient position for unloading and loading—which may progress during the return stroke. A weighted crank is frequently used to counterbalance the clapper, easing the movement and holding the fixture in position in loading and operating positions.

Some work, such as long rods, may be broached in a stationary fixture and without a receding table on the machine. This is accomplished by loading the parts through the fixture, then clamping, broaching and unloading the work before the broaches are returned. While loading and unloading must be done with the broaches at rest, this type of fixture is relatively inexpensive and quite efficient, as several parts are machined at a time. Short rods that



Portions of the head on this part are broached to coincide with the body. Setup provides for broaching two of these bushings simultaneously. The top of the head is beveled to a sharp corner at the hole, which necessitates taking the thrust on the opposite end. Work is done on a vertical surface broaching machine with receding table. A workholding arbor is mounted at right angles to the centerline of a rotating shaft which permits a 90 deg swing. The parts are loaded on each end of the stud while in the horizontal position. After loading it is brought to the vertical position, engaging receptacles in the upper and lower ends for position as well as support.

require machining of flats, notches or forms may be mass produced by broaching in multiples. The shape of the fixtures, method of loading and unloading vary in accordance with the type of machine to be used as well as the quantities of parts to be processed. The rods are positioned in V-shaped grooves in pivoted arms. Movement of the clamp handle in one direction opens the V-blocks sufficiently to receive the parts while handle movement in the opposite direction effects the clamping.

Some form of disappearing end stop is used so that the rods unload either by gravity when unclamped, or automatically pushed out by the parts being loaded, in case the parts are positioned in the horizontal plane. In order to efficiently handle several parts a ramp or vector, which loads all parts with a single movement, is installed on the fixture. This coupled with the automatic unloading feature permits stroking the machine with hardly any interruption.

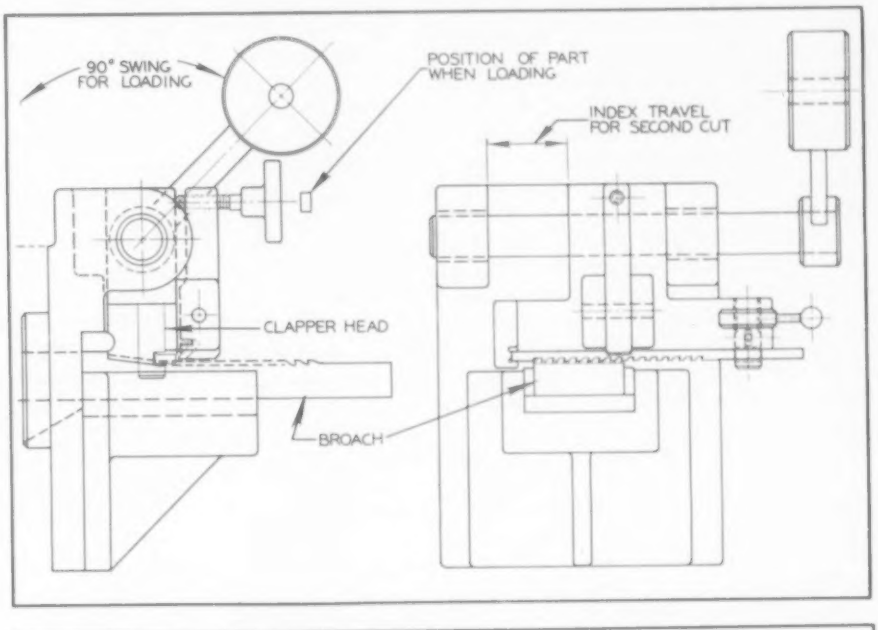
Very small parts, and parts with shapes that make them difficult to load, are locked in multiples in a magazine or receiver. The unit is removed from the fixture to facilitate loading and re-inserted for broaching by sliding the magazine into suitable ways in the fixture. With two or more magazines the interchange of parts may progress while the machine is in operation. As high as twenty-four parts have been known to be broached at one time with this method.

Efficient clamping for each type of fixture demands a good deal of study. The first consideration is adequate clamping. The part overhangs the rest anvil while the heavy broach thrust uses this overhang as a pry, tending to roll the part into the broach teeth. The clamp must then be powerful enough to overcome this tendency. Contact point of the clamp should be at some distance behind the edge of the rest anvil to counterbalance the leverage occasioned by the broaching forced on the overhang of the part.

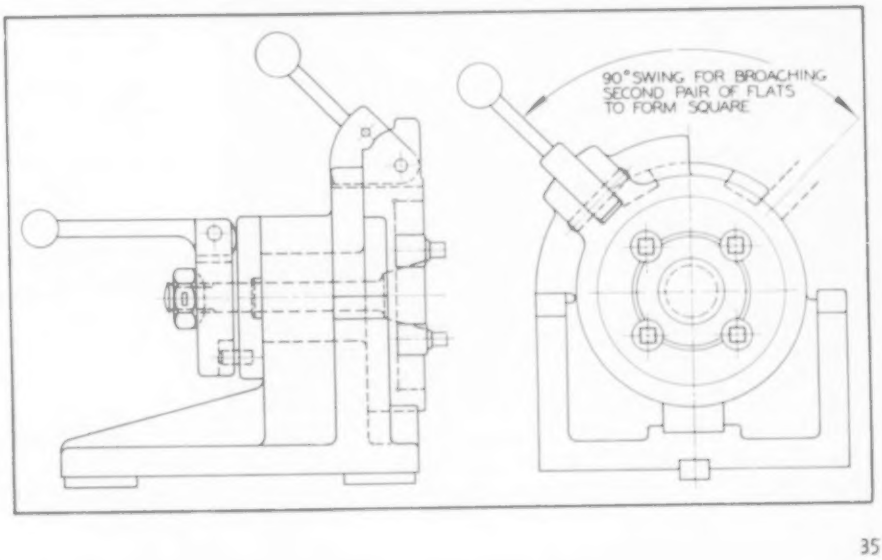
Clamping forces are applied by screws, cranks, wedges, cams and toggles. Each of these is selected in accordance with conditions to be met. The locks may be actuated manually, by power cylinders or by the shuttle stroke of the machine table. Aside from the clamping action these locks must further move the clamp far enough to clear the work piece for ease of loading. Another requirement is to keep the part in accurate position while automatic clamping occurs.

Work-supporting jacks are generally locked by wedges brought into place after the clamp has been locked, to avoid disturbing the location of the part. Resilient actuating means, such as springs with adjustable tension, bring the wedges into place. Wedge angles should be somewhat less than the limiting angle of friction, in order to keep the wedge stationary when cutting forces are applied.

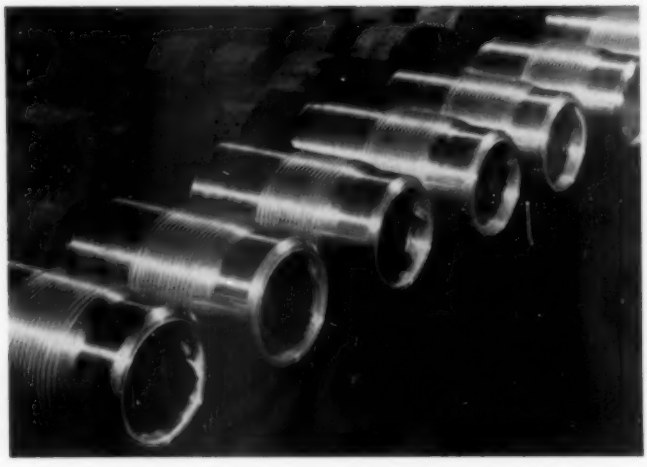
A properly constructed broaching fixture is well worth all the skill, precision and ingenuity contained in its makeup. Coupled with the right machine and a good set of broaches it will produce more parts, a better finish and higher accuracy from rough stock to finished surface than any comparable tooling in use at this time.



This buttress rack is broached in two cuts in a horizontal pull broaching machine with a single clamping. The workholding clapper swings 90 deg into the loading position by means of a weighted operating crank. There is sufficient space between the ears of the hinge to permit sliding of the clapper, hinge pin and the crank assembly into the two cutting positions, where an index pawl registers the longitudinal position accurately.



This operation consists of broaching male squares on four rods. Two cuts are taken, with the fixture indexed 90 deg between the cuts. Such a setup is suitable for use on a vertical surface broaching machine with a receding table.



This finished drill pipe is now ready for shrinking the tool joints.

Principles of C

AS APPLIED IN THE

CONTOUR TURNING and boring was introduced on a limited production basis during World War I using high speed steel turning tools. During the next two decades carbides were developed and made practical to use on a production basis and contour turning and boring was again used in mass production of shells and other miscellaneous items during World War II.

Tool joints, to many tool engineers not familiar or allied with the drilling industry, is a vague subject. However, we will brief a portion of the nomenclature of the example used in this article, which is a box and box tool joint. One box (female connection) represents the drill pipe connector (straight grip) which is a patented product in this case and is a shrink fit on the drill pipe. The other box (also female connection) is a standard A. P. I. (American Petroleum Institute) tool joint connector. There are numerous types and sizes of tool joints in variation used in the drilling industry which must be tooled very efficiently to be sold on a highly competitive market.

Tool joints (female connections) to the writer's knowledge, have always been made following the conventional method of rough machining with cathead or multi-cutter boring bars and finished with single or multi-stepped high-speed steel reamers. These tools were used on conventional turret lathes and in some instances used on automatics, semi-automatics and special machines.

Conventional Tooling Impractical

In setting up our production on the manufacture of tool joints, we tried to be conventional in equipment and tooling based on a conservative sales forecast. However, we found that due to the many different sizes and specifications of tool joints, the cost in maintenance of the many different boring bars, tools and reamers was prohibitive.

Necessity being the mother of invention, our thoughts leaned towards single point turning and generating the contour of the bores by means of a cam.

Our machines are conventional standard fixed center turret 3A Warner & Swasey turret lathes, equipped with two speed motors, 3-jaw chuck, power chuck wrench operated, and hardened and ground leader to facilitate leading the tap.

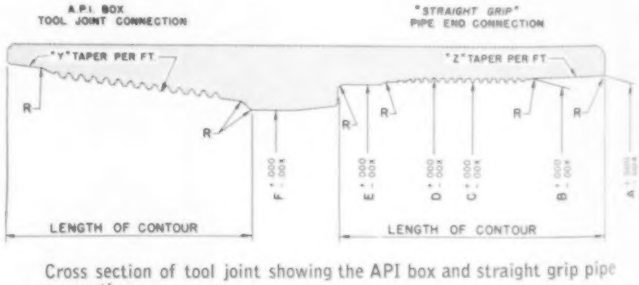
The contour boring attachment is revamped from a standard 3A Warner & Swasey slide tool. Two of these slide tools are used on the finish machine, one for the rough cut and the other for the finish cut. The threads in the straight grip box are 6-pitch modified Acme and are tapped in one cut with a National Acme 4 in. to 6 in. RST collapsible tap. Incidentally, tapping this thread on a production basis is somewhat unusual, the usual method being to mill the thread. We are assured of a close concentricity between the axis of the thread and the axis of the bore diameters by tapping. If the threads were milled, another chucking is required which causes minute eccentricities which may pyramid into errors affecting tolerances in the final inspection of the product.

The cam bar is overhead and is operated with the same simplicity and ease as a standard overhead pilot bar. The cam bar is secured in a cam carrier bar that fits into a bracket which in turn is bolted and dowelled to the head cover of the machine. The arrangement is similar to the standard bracket that holds an overhead pilot bar. The cam carrier bar is not in a fixed position and can be moved parallel to the axis of the spindle and clamped to facilitate machining different lengths of the various sizes of tool joints.

The cam bar is made of a carburized steel (0.060 in. case) hardened and drawn to a 64/66 R-C. The bar is ground to 0.0001 in. tolerances on the rise controlling diameters. The linear dimensions between the vertex of angles are held to a tolerance of plus or minus 0.003 in. The cam bar is hinged to the cam carrier so that it may be conveniently laid back, resting on top of the cam carrier, at the operator's will.

The bottom of the cam bar slides on a hardened and ground slide block secured in the stationary member of the slide tool, while the follower is secured to the front member of the slide tool. It is adjustable to facilitate diameter adjustment as well as to retract the tool at the end of the bore to prevent the tool from marking or scoring the bore when rapid traversing out. The front member of the slide tool is held in tension by means of a spring located in a block back of the stationary member, and heavy enough to keep the follower in contact with the cam at all times. The forces are equalized on the cam by the follower on top and the slide block supporting the cam directly under the follower. However, there is a slight thrust on the cam in the direction of the spindle against the hinge pin, and this is equalized by the adjusting screw in direct line with the force.

In changing from one setup to another, such as a straight grip box to an A. P. I. box, the major change is to remove the cam bar and replace with the other, then make the necessary diameter and stop adjustments which are minor compared to changing multi-cutter boring bars and reamers.



Cross section of tool joint showing the API box and straight grip pipe connection.

By Cecil Clark
TOOLING DIRECTOR
AMERICAN IRON AND MACHINE WORKS

Contour Turning and Boring

MACHINING OF TOOL JOINTS AND DRILL PIPE

The forgings come to the finish machine semi-finished with approximately 3/16 in. stock per side to be removed from the bore. The forgings are SAE 4140 steel heat treated to a BHN of approximately 300 to 320. A surface speed of 225 feet is used for all boring operations except tapping. Feeds for rough boring are 0.0167 in. per revolution and for finishing, .0124 ipr. Actual machining time for a 4½ in. A. P. I full hole straight grip tool joint box is 5.6 minutes, including threading.

We have experienced a superior quality product since employing the above methods due to exceptional dimensional control. Also, we have decreased our maintenance cost of tools and setups approximately 500 percent and increased our production 100 percent.

The drill pipe, which comes from the steel mills usually in 30-foot lengths, is an alloy steel with the ends forged or upset and normalized ready for machining the tool joint connections.

In machining drill pipe our practice is to contour turn the pipe ends, which is a duplicate contour to the straight grip tool joint pipe connection.

A standard 4-A Warner & Swasey turret lathe with fixed center turret is used equipped with a two speed motor, 3-jaw chuck, power chuck wrench operated with a 3-jaw lever operated tail chuck, hardened and ground leader to facilitate leading the die head.

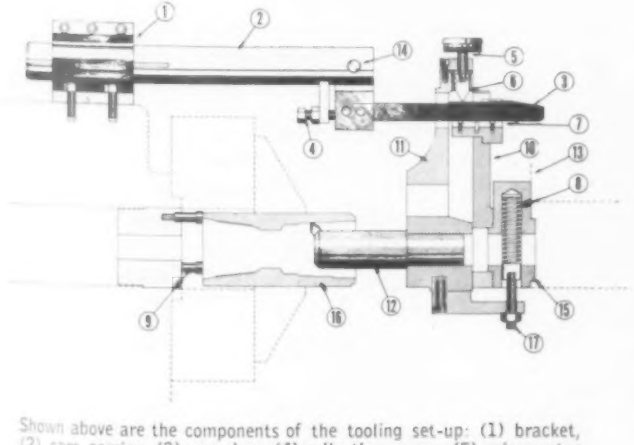
One rough and one finish carbide tipped tools are secured in the square turret for the contour turning operations. A special cam plate is secured to a standard side carriage taper attachment which generates the contour on the product.

The follower is a roller type with anti-friction bearings. The cross slide is held in tension by means of a heavy spring housed in a type and secured to the cross slide and side carriage apron cover of the machine.

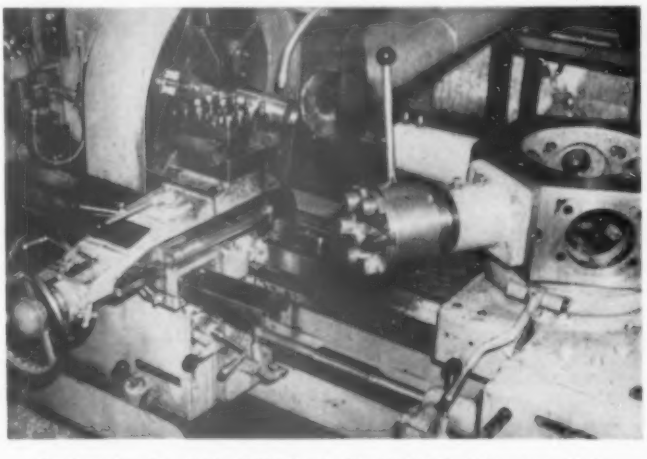
A combination end facing and chamfering tool, carbide tipped, is used to face the end of the pipe. A National Acme 4-7/8 D. S. circular chaser die head is used to cut the threads, which are 6-pitch modified Acme and held to close tolerances and high quality finish.

The salient features of the contour turning and boring on tool joints and machining drill pipe are summarized as follows:

1. Initial tooling costs are a fraction of the cost as compared to multi-cutter rough and semi-finish boring bars and reamers for tool joints. Similarly with reference to tooling on drill pipe versus multi-cutter hollow mill type tools.
2. Setups are reduced to a minimum due to the few tools used, all of which are standard carbide turning and boring tools.
3. Operator gaging time is minimized to the use of one gage only for spot checking. The cam acts as the master gage.
4. Increased production due to tooling and operational simplicity.
5. Last but not least (as the tool joint is a shrink fit on the drill pipe) we are experiencing a uniform concentration of stress in the assembled product due to the controlled uniform diameters on both male and female members of the product within the limits of the given tolerances.



Shown above are the components of the tooling set-up: (1) bracket, (2) cam carrier, (3) cam bar, (4) adjusting screw, (5) micrometer adjusting screw, (6) cam follower, (7) wear plate, (8) spring, (9) work stops, (10) stationary member of slide tool, (11) sliding member or slide tool, (12) boring bar, (13) face of hex turret, (14) hinge pin, (15) auxiliary block, (16) tension adjusting screw.



Contour turning of the drill pipe is illustrated in this view of the tooling set-up on a Warner and Swasey turret lathe.

By Gilbert P. Muir

Machining High Nickel Alloys

THE NICKEL ALLOYS, used primarily for applications requiring resistance to corrosion, possess high strength, ductility and hardness. Since these values are for the most part greater than those found in the lower-alloyed steels, machining and tool design are modified slightly for optimum results.

Tool Materials

An important consideration in tool material selection is that the material have high red hardness, since the nickel alloys generate considerable heat during the machining operation. Among the high speed steels those containing cobalt are recommended as possessing this requirement, as well as longer life between regrinds. Next in preference follow the cast non-ferrous and cemented carbide tools. Table I lists a number of commonly-used tool materials for nickel alloys.

Table I—Some Commonly-Used Tool Materials for High-Nickel Alloys

Cutting Material	General Classification
18-4-1 High speed steel	High tungsten, chromium, low vanadium
18-4-1 plus Cobalt, High speed steel	High tungsten, chromium, cobalt, low vanadium
18-4-2 High speed steel	High tungsten, chromium, high vanadium
18-4-2 plus Cobalt, High speed steel	High tungsten, chromium, cobalt, high vanadium
14-4-2 High speed steel	Low tungsten, chromium, high vanadium
14-4-2 plus Cobalt, High speed steel	Low tungsten, chromium, cobalt, high vanadium
Molybdenum, High speed steel	Types produced are: Molybdenum, tungsten, molybdenum, tungsten, cobalt; molybdenum, tungsten, cobalt, high vanadium; tungsten, molybdenum; and molybdenum, vanadium
Cast non-ferrous	Cobalt, chromium, tungsten, carbon
Cemented carbide	Tungsten carbide; tungsten titanium; carbide; tungsten tantalum carbide

Tool Design

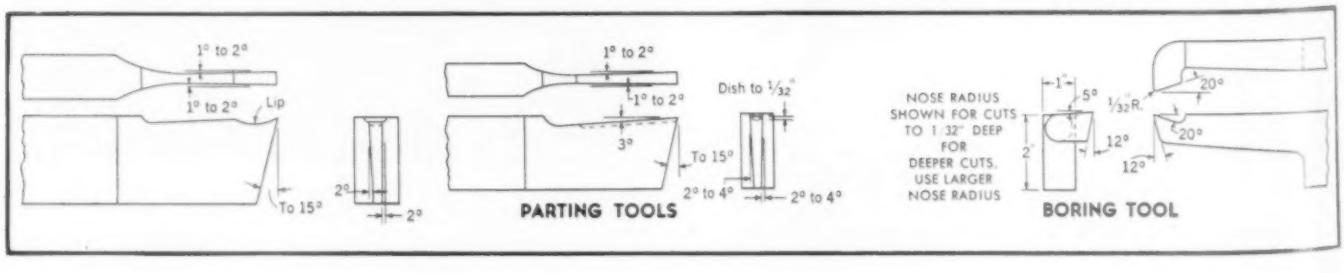
In general, design of high speed steel tools for machining the nickel alloys are much the same as for other tough materials. (The design of carbide tools for machining will not be covered here.) Some fundamental principles for proper tool design follow:

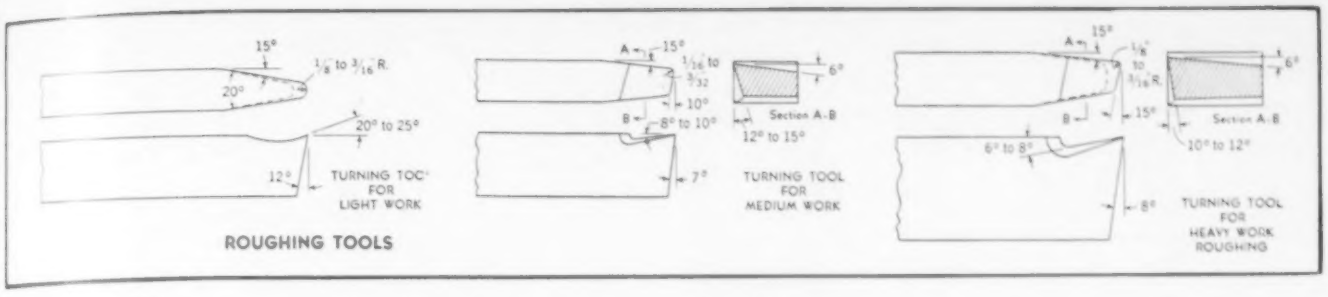
1. Clearance angles should be held to the minimum; this will provide needed support for the cutting edge.
2. Grind sufficient true rake on the tool face to keep chip pressure, chip abrasion, and resultant frictional heat at a minimum and provide for good chip disposal.
3. Leave as much metal as possible at the nose of roughing tools.
4. Support tools well, allowing as little overhang from the tool post as possible.
5. When necessary, use chip breakers to provide for chip control.
6. Use a tool with a side cutting edge angle wherever possible. This angle will reduce the unit pressure on the tool by spreading the chip over a greater area, and will protect the nose of the tool by taking shocks at a point back from the nose, where the tool is stronger.
7. Do not use too large a nose radius, since this may result in excessive pressure between the tool and the work and reduce tool life. Generally a radius of from 1 to 3 times the feed used is satisfactory.
8. Use tools having a sufficient cross-section to assure rigidity while in the cut.
9. Make certain that enough metal is ground from a newly-heat treated tool to remove any decarburization.

A lathe-turning tool for normal feeds and cuts would have a front and side relief of approximately 7 deg, an end-cutting edge angle of 10 deg, a side-cutting edge angle of 15 deg, a back rake of 8 to 10 deg, a side rake of 12 to 15 deg, and a nose radius of from 1/16 to 3/32 in.

Grinding of clearance angles in shops where the work can be held accurately should provide for an angle of from 6 to 8 deg. In shops where the machinist grinds his own tools, it is advisable to specify 10 to 12 deg to prevent grinding too small an angle. Finishing tools may have front clearance angles of 15 deg, and should have large back rakes to give sharp cutting angles.

The rake angle is the critical angle of the cutting tool, and it is even more important when working with the high nickel alloys because of the higher pressure exerted on the tool, the difficulty of chip disposal and the higher frictional heat. The side and back rake can range from 8 deg for heavy, dry roughing to as high as 25 deg on smaller lathe-turning tools and finishing tools where the amount of metal removed is small, the work is well lubricated, and chip disposal is not difficult. Of prime importance in heavy roughing is chip disposal, and this can be alleviated by using chip breakers. A heavy, continuous spiral chip cannot be handled economically when chip breakers are not used; so it is advisable to disregard certain principles of tool design and reduce the rake angles to a degree where the heavy chip will pack





ROUGHING TOOLS

against the tool face, become embrittled, and break when it curls back against the work.

Cutting Fluids

Proper selection of cutting fluids is essential when working with high nickel alloys, (1) because of the higher heat developed in machining, and (2) cutting speed may be increased up to 25 percent over that possible with dry cutting. Some suitable compounds for various classes of work are given in Table II.

Table II—Cutting Fluids for Machining High-Nickel Alloys

Operation	Cutting Lubricant *
Rough turning	Sulfurized, dry or water-soluble oil
Finish turning	Sulfurized, or water-soluble oil
Rough planing	Water-soluble, dry, or sulfurized oil
Finish planing	Water-soluble, or sulfurized oil
Shaping	Water-soluble, dry or sulfurized oil
Milling	Sulfurized oil or water-soluble
Drilling under 1/8 in.	Turpentine, or gasoline
Drilling 1/8 to 1/4 in.	Sulfurized oil (cut)
Drilling over 1/4 in.	Sulfurized oil, or water-soluble oil
Threading	Water-soluble oil
Tapping	Sulfurized oil
Boring	Sulfurized oil
Reaming	Sulfurized oil
Broaching	Sulfurized oil
Cold sawing (Low-speed circular saw)	Sulfurized oil, or water-soluble
Cold sawing (Hack saw, etc.)	Sulfurized, or water-soluble oil
Grinding	Water-soluble oil, water with rust inhibitor

*For the operations where there are two or more cutting lubricants suggested, the one mentioned first is considered preferable.

All lubricants should be completely removed from the machined pieces that are to be subjected to high temperatures, either during subsequent fabrication, or in service.

A series of tests by Boston and Gilbert[1] show the following results:

A rich emulsion of one part of soluble oil to 15 parts of water materially increased the cutting speed values for any tool life over those of the lean mixtures composed of one part of soluble oil to 50 parts of water.

Using a rich emulsion of soluble oil permitted a maximum increase of 22.7 percent in the cutting speed over dry cutting speed.

All cutting force components are highest when cutting dry; they are intermediate when cuting with an emulsion of soluble oil and lowest when cutting with the sulfurized mineral oil.

Turning and Boring

The machine set-up for turning and boring high nickel alloys is much the same as for steel, with emphasis on rigid mounting of the tool and a sturdy, rigid machine.

In Table III are speeds, feeds and cuts based on a series of tests conducted on Monel by Matsen[2] at Montana State College. These data are based on dry cutting, and for proper lubrication the speeds may be increased about 20 to 25 percent. Cuts, feeds and speeds for the other materials are estimated, and are sufficiently accurate to serve as a guide.

Further investigation has shown[1] that for best tool life it is more practical to take a deep cut and light feed when turning or boring than to take a light cut and a heavy feed. It is noted that "for a given value of tool life when the feed is 0.0127 in., by increasing the depth of the cut 0.025 in. to 0.150 in., or 500 per cent, the cutting speed is reduced only 28.8 percent. If the feed is increased from 0.0127 in. to 0.0255 in., or 100 percent, the depth remaining constant at 0.025 in., the cutting speed is reduced only 22.4 percent. Similarly, for a constant feed of 0.0127 in., a 100 percent increase in the depth of cut from 0.025 in. to 0.050 in., results in reducing the cutting speed 14.1 percent."

For boring operations, the speeds given in Table III must, in most cases, be reduced, since the same cooling and lubricating efficiency cannot be obtained in internal cutting.

Drilling Operations

For most drilling applications, standard twist drills can be obtained from the various manufacturers which have an included angle of 118 deg, a chisel point angle of 130 to 135 deg, and a clearance angle of from 12 to 15 deg.

High speed steel drills of the heavy-duty type are recommended, with a heavy parallel web. The web of the drill should be thinned at the chisel point. For the harder nickel alloys ("K" Monel and Inconel) cobalt high speed steel drills are recommended for longer life.

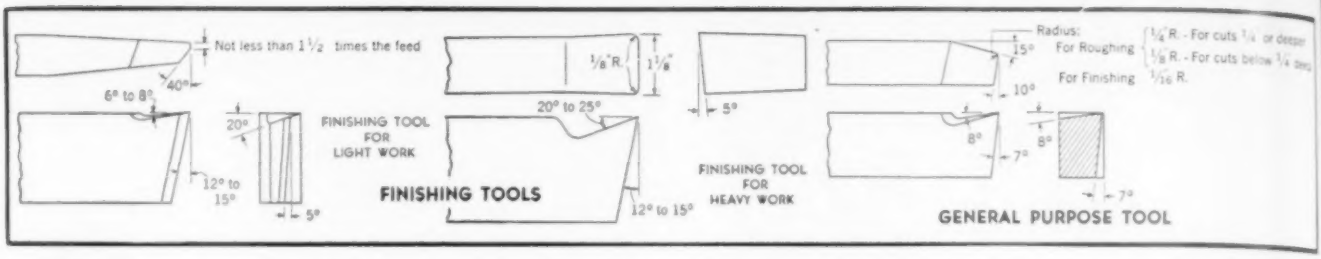
In Table IV are given general recommendations for speeds and feeds in drilling the high nickel alloys. Because of the many variables involved, these are approximations.

An abundant supply of lubricant should be flowed on the cutting edge of the drill in operation. For most holes of average depth, the water-soluble oils are satisfactory, but the

Table III—Recommended Cuts, Feeds, and Speeds for Lathe-Turning Nickel Alloys

	Depth of Cut (in.)	1/32	1/16	3/32	1/8	5/32	3/16	1/4	1/4	1/4	5/16	5/16	5/16	1/2	1/2	1/2
	Feed (in.)	0.008	1/64	1/32	1/64	1/32	1/16	1/64	1/32	1/16	1/32	1/16	1/8	1/32	1/16	1/8
Speed ft per min.	Wrought Monel Wrought "R" Monel Wrought "KR" Monel (Unhardened) Wrought Nickel	168	139	118	121	104	60	110	68	48	34	57	39	29	52	34	24	49	31	21
	Wrought "K" Monel (Unhardened) Wrought Inconel	115	85	75	75	65	40	70	45	35	25	37	27	20	30	25	15	32	20	15
	Wrought "K" Monel (Hardened)								25	15										
	Cast Nickel		110	95	95	80	55	85	60	55	35									
	Cast Monel		90	80	80	70	45	75	50	40	30									
	Cast "H" Monel Cast "S" Monel (Annealed)		60	55	55	45	30	50	35	25	20									
	Cast "S" Monel (As Cast)		30	27	27	22	15	25	17	13	10									

NOTE: The broken lines block off a speed range which is suggested as a starting point for all jobs. Adjust the operating speed from this point to obtain maximum efficiency.



harder alloys require a sulfurized oil. In deep drilling, provision should be made for forced drilling, such as oil hole drills. Where oil hole drills for the smaller diameters are not available, special deep hole drills are made for the purpose. Thinning out sulfurized oils with kerosene will also aid in supplying the proper amount of lubricant when drilling small diameter holes.

Reaming of High Nickel Alloys

Reaming operations, necessary only when a high finish is desired, should be performed with a generous supply of sulfurized oil. High speed steel reamers are recommended, with margins at the cutting edge of about 0.005 to 0.015 in. While spiral-fluted reamers provide smoother cutting action and are less likely to dig in, the straight-fluted reamers are recommended for high accuracy.

Reaming speeds are about one-half those suggested for the same size drill. The feed for end-cutting reamers is about 2 to 3 times that for the same sized drill, and for side-cutting reamers, approximately 3 to 5 times that for a corresponding drill.

The usual allowance for Rose (end cutting) reamers does not exceed 0.015 in.; the exact allowance will depend upon the bore finish and the diameter of the hole. Generally the allowance for holes up to 1 in. diameter is about 0.004-0.007 in., and this increases gradually with the diameter to the maximum allowance.

Tapping

Tapping operations on the high nickel alloys should, like other machining operations, be done with additional allowance for the added toughness of the material. General recommendation is to use a tap drill of slightly larger diameter than that used on a specific standard thread. High speed steel 4-fluted plug taps with ground threads and 7 deg spiral flutes are suggested for machine tapping, or the 4-fluted, spiral-pointed plug taps. The flutes should be ground to approximately a 15 deg lip.

A slight back taper, and a relief on the angle of the thread and on the major diameter of the thread of at least 2/3 the width of the land will guard against the tap becoming wedged and consequently causing torn threads. Grinding a hook of about 5 to 8 deg on the heel of each land will also prevent this condition.

Lubrication is important in tapping, since the high nickel materials have a tendency to gall on the tap. For machine tapping, a strong stream of sulfurized oil pumped into the hole is recommended. The oil is ordinarily cut to the proper viscosity with kerosene, or if that is not available, a good grade of light machine oil can be used. Where the machine is not equipped to pump the oil onto the work, a heavy sulfur-base oil should be smeared on the tap. This serves the added function of holding the chips in the flutes.

Broaching

Broaching of the high nickel alloys follows conventional practice to the extent that, in most cases, the standard formula for relationship of pitch, feed and cutting angles ($P = 0.35\sqrt{L}$) can be used. There is some deviation from this, as for example in the broaching of long holes, where the pitch must be increased to allow additional chip space. The increased pitch also results in less power being used, since

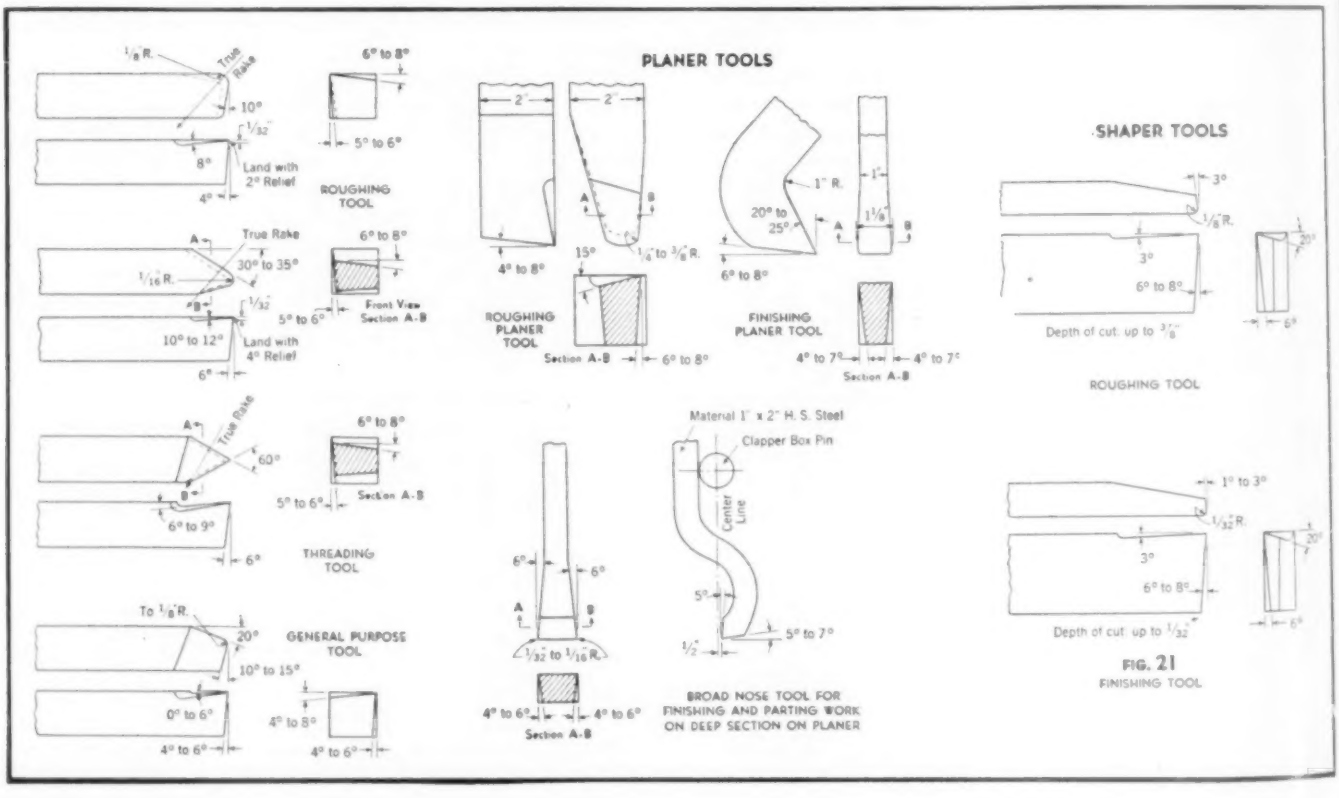


FIG. 21
FINISHING TOOL

Table IV—Suggested Feeds and Speeds for Drilling

Monel "KR" Monel (Unhardened) Nickel				Inconel				"K" Monel (Unhardened)			
Drill Size in.	Speed ft. per min.	RPM.	Feed per rev.	Drill Size in.	Speed ft. per min.	RPM.	Feed per rev.	Drill Size in.	Speed ft. per min.	RPM.	Feed per rev.
1/16	50	3055	0.0015	1/16	40	2445	0.0015	1/16	25	1525	0.001
1/32	50	2100	0.0020	1/32	40	1645	0.0020	1/32	25	1050	0.0015
3/64	50	1525	0.0025	3/64	40	1220	0.0025	3/64	25	765	0.002
1/16	50	1020	0.003	1/16	40	815	0.003	1/16	25	510	0.0025
5/64	60	920	0.0035	5/64	45	685	0.0035	5/64	30	460	0.003
3/32	60	735	0.004	3/32	45	550	0.004	3/32	30	370	0.0035
7/64	60	610	0.0045	7/64	45	460	0.0045	7/64	30	305	0.004
1/8	60	525	0.005	1/8	45	395	0.005	1/8	30	265	0.0045
9/64	60	460	0.0055	9/64	45	345	0.0055	9/64	30	230	0.005
5/32	60	405	0.006	5/32	45	305	0.006	5/32	30	205	0.0055
11/64	60	365	0.007	11/64	45	275	0.007	11/64	30	185	0.006
3/16	60	335	0.008	3/16	45	250	0.008	3/16	30	170	0.0065
13/64	60	305	0.009	13/64	45	230	0.009	13/64	30	155	0.007
7/32	40	190	0.010	7/32	30	140	0.010	7/32	20	95	0.0075
15/64	40	175	0.011	15/64	30	130	0.011	15/64	20	90	0.008
1/4	40	165	0.012	1/4	30	120	0.012	1/4	20	85	0.008
1	40	150	0.013	1	30	115	0.013	1	20	75	0.009
1 1/16	40	135	0.014	1 1/16	30	100	0.014	1 1/16	20	67	0.009
1 1/8	40	120	0.015	1 1/8	30	90	0.015	1 1/8	20	60	0.010
1 3/16	40	115	0.015	1 3/16	30	80	0.015	1 3/16	20	57	0.010
1 1/4	40	102	0.015	1 1/4	30	75	0.015	1 1/4	20	54	0.010
1 5/16	40	100	0.016	1 5/16	30	70	0.016	1 5/16	20	50	0.011
1 3/8	40	85	0.016	1 3/8	30	65	0.016	1 3/8	20	43	0.011
1 7/16	40	80	0.016	1 7/16	30	60	0.016	1 7/16	20	40	0.011
2	40	75	0.016	2	30	57	0.016	2	20	38	0.012
2 1/16	40	65	0.016	2 1/16	30	50	0.016	2 1/16	20	32	0.012
2 1/8	40	60	0.016	2 1/8	30	45	0.016	2 1/8	20	30	0.012
2 1/4	40	55	0.016	2 1/4	30	42	0.016	2 1/4	20	27	0.012
3	40	50	0.016	3	30	38	0.016	3	20	25	0.012

there are fewer teeth on the broach, and this is of some help, in that the stress on the cross-section of the broach is reduced.

The following steels are satisfactory for broaching the high nickel alloys:

(a) High speed steel of about 18 percent tungsten, 4 percent chromium, 1.00 percent vanadium, with about 0.70 to 0.75 percent carbon.

(b) Molybdenum-tungsten high speed steel, with approximately 4.5 percent molybdenum, 5.5 percent tungsten, 4.5 percent chromium and about 0.80 to 1.25 percent carbon.

(c) Super-high speed steel of about 18.00 percent tungsten, 4.00 percent chromium, 5.00 percent cobalt, 2.00 percent vanadium, with 0.75 to 0.80 percent carbon.

Broaches should be hardened and tempered to about 64 Rockwell C, and should at all times be kept sharp with teeth polished and honed to a keen edge.

Sulfurized mineral oil is recommended for lubrication with the high nickel alloys, and should be supplied in generous quantity to the work.

Planing

Since the cutting action is similar, there is little difference in the cutting tools for turning and planing of the nickel materials. Chips from the nickel alloys are springy, and a small, curling chip that curves and breaks when it hits the work is desirable.

Typical tools for roughing and finishing on the nickel alloys are shown in the illustrations. Roughing cuts in general should be taken down to about 0.025 in. of the desired dimension, leaving the balance for the finishing cut. Parting of heavy sections on the planer is done with a blunt-nosed tool, and should be performed with light cuts not exceeding 0.005 to 0.010 in. per stroke.

For roughing operations on the planer, lubrication is not necessary, but finishing and parting work should be well lubricated. For Monel and nickel, a good soluble oil is satisfactory, but for the harder alloys a sulfurized oil is recommended. Lubrication is best handled by having the fluid drip on the work continuously, but if this is not possible the work should be smeared with oil before taking the finishing cut.

In general, a table speed of 25 to 35 fpm for Monel and nickel is satisfactory, and about 15 to 20 fpm is recommended for unhardened "K" Monel and Inconel.

Milling

Recommended material for milling the high nickel materials, unless cemented carbides are used, is high speed steel —either of the regular or cobalt type. Again, lubrication and sharp cutting edges are essential to a successful operation. A sulfurized oil is suggested for lubrication.

As in lathe turning, the chips formed in milling do not break up, but have a tendency to curl. Chip control is facilitated by ample space between the teeth, even to the point of reducing the number of teeth in the cutter; incorporating a positive 15 to 20 deg rake angle, particularly for deep cuts.

Heavy-duty, spiral-fluted designs are recommended for plain or slabbing milling cutters, since the continuous engagement of the work with this type produces smooth cutting action. For milling deep holes, or for slitting, alternate-tooth or interlocking side millers prove effective. Here the staggered teeth break up the cut and eliminate chatter.

Face milling cutters with inserted teeth of high speed steel are designed so that the inserted teeth have positive rake and positive helix angles. One design provides for the set into the head at a positive rake angle of 7 deg and a positive helix angle of 15 deg.

Feeds for milling Monel and nickel with high speed steel cutters averages 0.005 to 0.010 in. per tooth at a speed of 50 to 60 fpm, under favorable conditions. For the harder materials the speed is reduced to approximately 40 fpm, with a feed of from 0.003 to 0.006 in. per tooth. The average depth of cut should be about 1/8 in. deep, and should rarely exceed 1/4 in. Milling speeds can be increased up to about 50 percent of those given here when taking light finishing cuts.

References

1. "A Study of Cutting Fluids Applied to the Turning of Monel", by O. W. Boston and W. W. Gilbert, Ann Arbor, Mich. Trans. ASME, Vol. 58, No. 8.
2. "Lathe Cutting of Monel", by Melvin Matsen, Montana State College. *The Iron Age*, Vol. 138, Sept. 10, 1936.

Data through the courtesy of The International Nickel Company, Inc.

Cutting tools may now be cast with marked savings over conventional methods of manufacture

Precision Toolmaking via "Lost-Wax" Casting

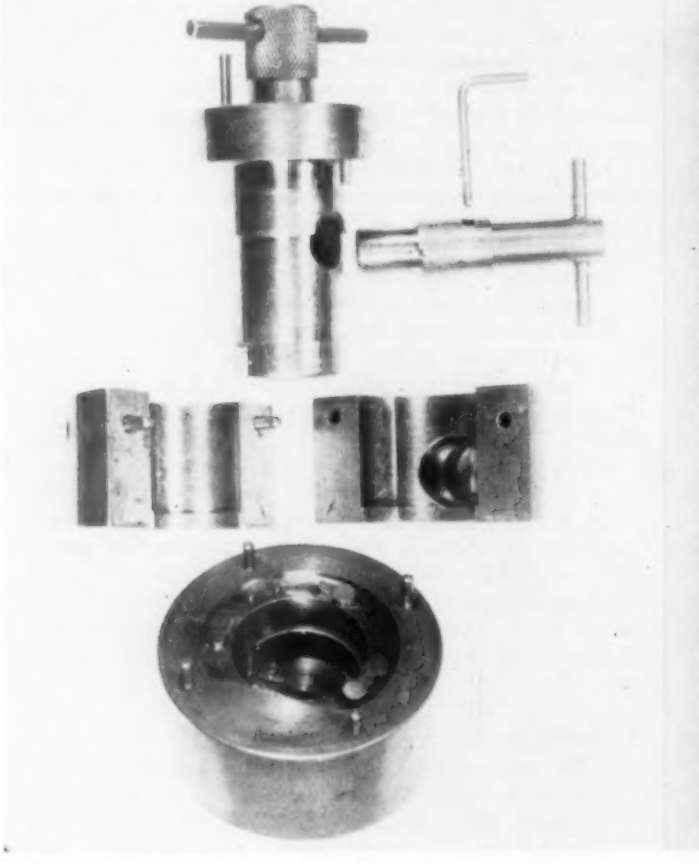
By A. E. Rylander

WHILE THE "LOST-WAX" process for precision casting is generally known by now, late developments have brought about refinements that considerably increase its scope, especially in the making of tools. A number of concerns—notably one prominent automobile manufacturer—have been casting milling cutters and stepped cutting tools for some time. But there the casting has followed convention practice in that the tools have been sand cast. And, while tools so cast may be entirely satisfactory for all practical purposes, such casting precludes precision as that term is ordinarily understood.

With the lost-wax method, however, the tools may be cast to such close limits of tolerance that, except for heat-treating, they may be ground without any in-between machining. For example, both the hole and teeth in a milling cutter may be cast to grinding tolerances and then ground so that the finished product will compare favorably in appearance with a tool machined from the solid. Tools may be cast from the full range of tool steels—oil and water-hardening, high-speed, moly—with the exception of tungsten carbide.

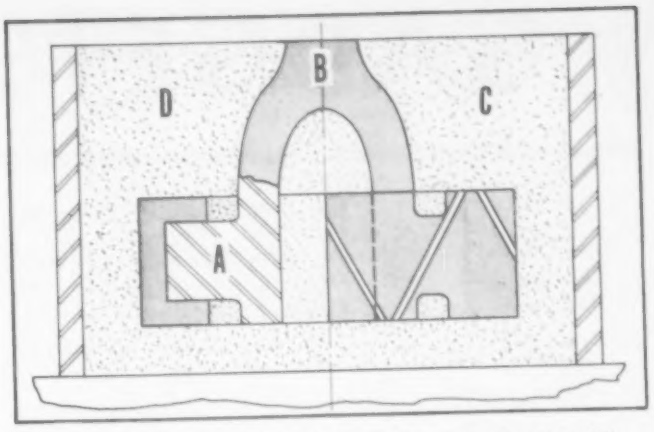
For the benefit of any who may be unacquainted with the lost-wax process, a brief description of the steps involved may be in order for a clearer understanding. Reduced to essentials, these steps are:

(1) Produce a model of dimensions that will compare favorably with the dimensions of the finished product while yet compensating for the shrinkage of the metal to be cast. (2) This model is then used to make the mold which, to all practical purposes, is a "core-box" comparing in precision and finish to a die-casting die and used to produce the wax pattern. It might be explained, here, that while a mold can be made from the blue-print in some instances, the model serves as a pattern for tracer-controlled ma-



Shown at left is a typical mold, such as used for making the wax patterns for "lost-wax" casting. Comparable in function to the core box is used in conventional casting practice, these molds are precision made and, in some instances, held to limits of tolerance plus or minus 0.0005 in. The components are so made that the mold can be separated without damage to the wax pattern, yet so precisely fitted that, when locked together, there is exact duplication of patterns. At right is a wax pattern of an aircraft part imbedded in a sawed-through section of plaster-of-paris investment. Compare with the sketch of a milling cutter shown on the following page. It should be noted, however, that the investment entirely surrounds the patterns: hence, there is no parting line or lines which might tend to distort the casting.

A cluster of precision-cast parts, exact counterparts of the original wax patterns. The patterns are gated together, much as in conventional casting practice, and the resultant "Christmas tree" is then surrounded by plaster-of-paris investment. Next, the wax patterns are completely disintegrated by heat and the resultant cavity is then a reversed or inverted duplicate of the original pattern or gated assembly. Photograph by courtesy of Precision Metalsmiths, Inc., Cleveland, Ohio.



While plain straight-sided milling cutters may be successfully cast without resort to the "lost-wax" method, a cutter such as shown, with reverse-angle stagger indicated, would require a master mold. This mold would make the wax pattern and sprue, designated by A and B. The "flask" designated by C—is usually made of heat-resisting alloy metal of sufficient diameter and height to contain the pattern and surrounding investment, the latter designated by D. The molten metal is poured into the cavity through the gate at B.

chining of tooth forms and other contours incidental to the tool to be cast. (3) The wax patterns are gated and mounted on a sprue, sometimes referred to as a "Christmas tree." A steel jacket or "flask" is placed over the pattern assembly, and into this flask is poured the investment which consists of plaster of paris. During pouring, the flask is agitated so that the investment will fill every interstice. (4) The assembly is then placed in an oven, under controlled temperature, to permit the investment to set as well as to melt the wax pattern. Heat is then increased to approximately 1800 deg F. to assure the complete disintegration or burning out of the wax. When the wax is completely consumed, the cavity left in the investment corresponds exactly with the pattern itself. The term "lost-wax process" is derived from this total disintegration of the wax.

As implied above, castings may be produced from steels of various specifications; also from such metals as brass, aluminum, beryllium, beryllinm nickel, copper, magnesium, monel or stainless steel. While dimensions of plus or minus 0.002 in. are fairly common, dimensions may occasionally be held within 0.0005 in., depending on the design complications of the part to be cast. Parts with holes as small as 0.033 in.—or No. 66 drill size—are being cast in production quantities.

Infinite Duplication of Parts

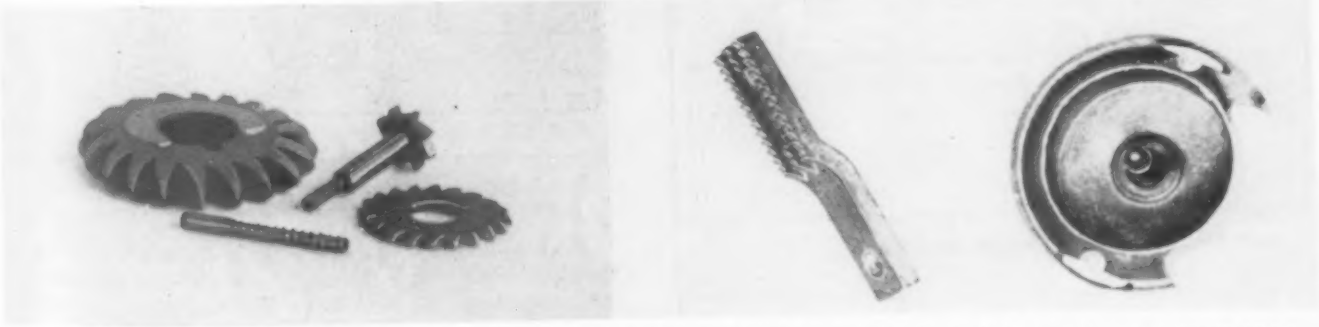
Considering the close tolerances attainable, and further in view of the fact that parts may be precisely duplicated as long as the mold retains its accuracy—and that would be practically infinite since wear from the wax is negligible—the economies to be effected by lost-wax production of tools and parts is considerable. One need only visualize the difference in cost between casting to grinding size—and, sometimes, to complete finish size—and machining such an item as a stepped counterbore from the solid.

It's not alone in machine time that savings are effected. There is a saving in original investment and maintenance of cutting tools ordinarily used to machine the parts; in the elimination of or diversion to other work of capital investment machine tools; and, in many instances, in the elimination of jigs fixtures, index heads and other accessories that ordinarily, would be tied up in the production of duplicate parts or tools.

Essentially a Mass Production Tool

It is not to be inferred, from the foregoing, that lost-wax casting will displace conventional practise in the manufacture of cutting tools; certainly it is not practical in small-lot manufacture of special tools since the cost of the mold alone would cancel out any possible savings. Mold cost must be absorbed in mass-production runs. Nor will it displace the toolmaker, of whom even greater skill is demanded in the manufacture of precision molds. The "lost-wax" process is essentially a mass-production "tool" and, as such, has a definite place in the scheme of modern industry.

The variety of parts and tools that can be precision cast by the lost-wax process is almost unlimited. Shown herewith, however, are typical parts that lend themselves to precision casting, as well as illustrations of procedure, that are indicative of the marked economies as compared to conventional methods of production.



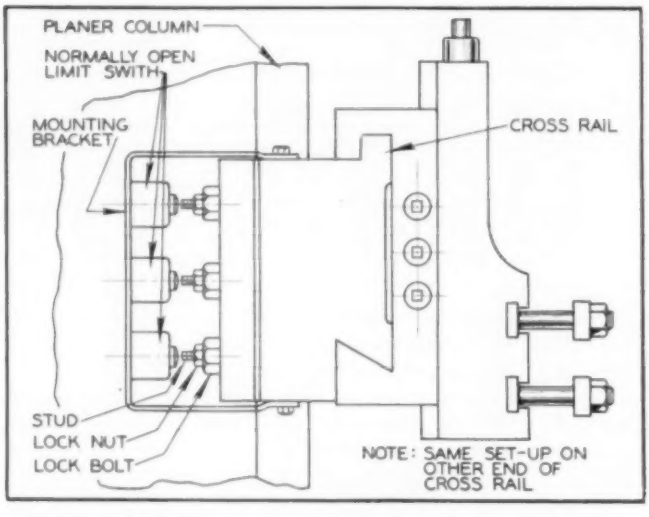
Shown at left, above are miscellaneous cutters, including a broach, which have been precision cast by the lost-wax process. The convex cutter at left is about 3 in. in diameter, and the horseshoe shaped segment indicates the sawed-off sprue. Duplication is practically as exact as the original model, allowances being made for metal shrinkage. Shown at right is a sewing machine shuttle and feed, the former cast from tough beryllium nickel. As indicative of the economy of lost-wax casting, this part is said to be produced at 45c each, with grinding time to finish about 5 minutes—a total of about 70c per piece. The original cost of the machined part is said to have been $1.19; thus, the saving is about 60 percent. The parts illustrated were cast at the plant of Precision Metalsmiths, Inc., Cleveland, Ohio.

GADGETS

Ingenious Devices and Ideas to Help the Tool Engineer in His Daily Work

Limit Switches Protect Planer Crossrail Lifting Mechanism

Many of the larger planers, where the cross rail is raised and lowered by a screw operated by an electric motor and gearbox, are not protected by shear pins or such safety devices. Frequently, through operator carelessness or accident, the motor will be started without first loosening the bolts that lock the cross rail to the columns. The usual result is expensive damage to the motor, gearbox, or feedscrew nut, with lost production time while repairs are made. The illustration shows a method that eliminates this trouble.



Limit switches protect cross-rail mechanism on large planers.

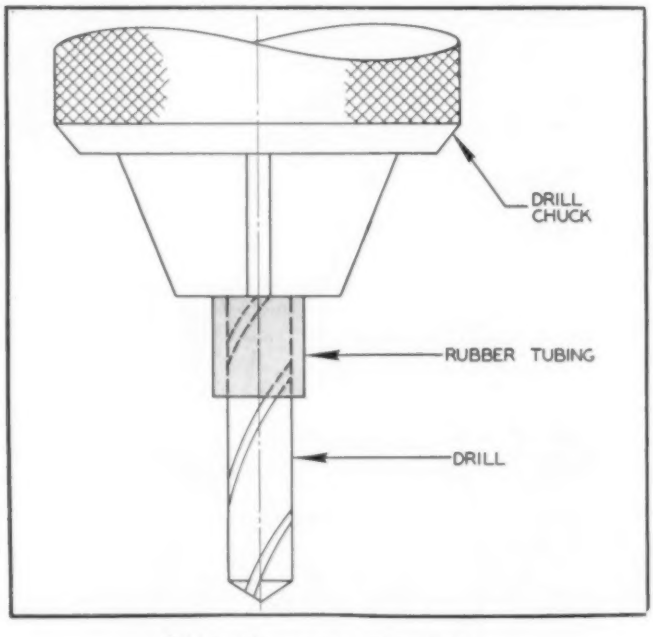
Two brackets, of which only one is shown—the other being on the opposite end of the cross rail—are made of 16 gage x 2 in. steel strip and mounted as shown with machine screws. A plunger type, normally open limit switch is placed opposite each of the lock bolts. The heads of the lock bolts are drilled and tapped for 3/16 studs, which are put in and locked with lock nuts.

All limit switches—both ends of the cross rail—are wired in series with the switch that controls the cross rail raising and lowering motor, and all studs in the lock bolts are adjusted so that the lock bolts must be free before the limit switches will close. In this way, all the lock bolts must be loosened before the raising motor will operate; thus the motor and gearbox will not be ruined by attempting to raise or lower a locked crossrail.

Geo. W. Brown
Toccoa, Ga.

Rubber Protects Finish

When drilling holes in parts that have delicate finishes, trouble is often encountered by the drill press chuck marring or scoring the surface of the work when the drill breaks thru.



Rubber tube protects surface finish.

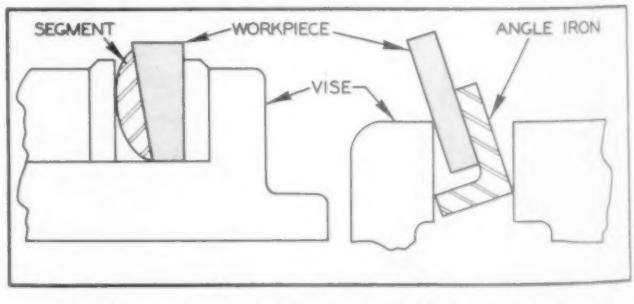
This can easily be prevented if a small length of rubber tubing is forced over the drill up against the chuck. The tubing acts as a stop making it impossible for the chuck to come in contact with the surface of the work.

Roger Isetts
Kenosha, Wis.

The Tool Engineer pays regular page rates for accepted contributions to these pages, with a minimum of $5.00 for each item.

Work Holding Methods

Shown here are suggestions for holding work in a vise. At left is a method for holding conical or wedge-shaped parts. A segment—it can be a large woodruff key—is placed against one side of the workpiece; this will align itself with the angular surface and provide a firm grip. The principle can be broadly applied to fixture design.



Odd shaped or plane workpieces may be held in a vise and otherwise securely gripped by means as illustrated.

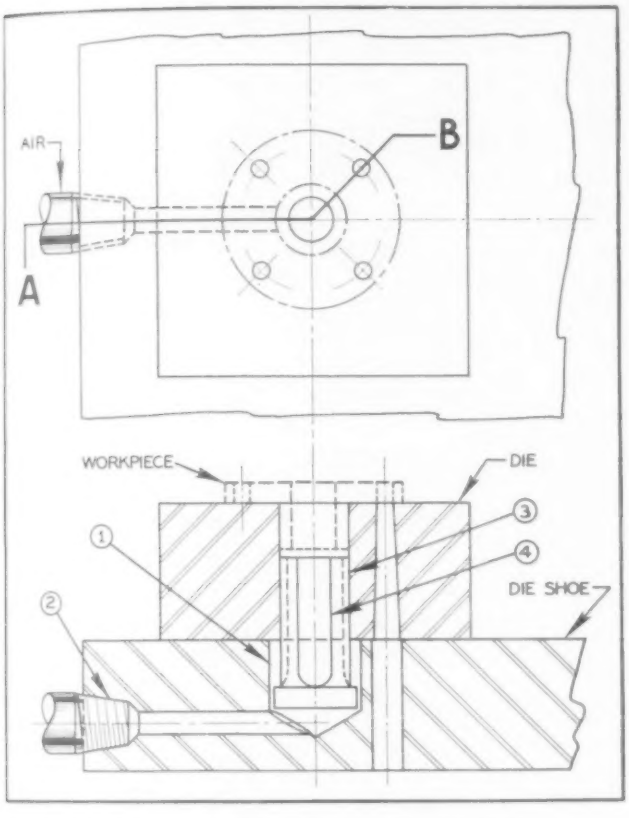
To hold a plane workpiece at a desired angle—as, for example, when filing clearance in a die—the part may be securely gripped by means of a short length of fairly heavy angle iron, as shown. In this connection, the leg of the angle iron must be above the top surface of the vise, as the distance "X" determines the inclination of the angle "A".

Federico Strasser
Santiago de Chile

Ejector for Punch Press

The device shown is useful for ejecting screw machine products from such second operation dies as may be used for coining, embossing or piercing—as, for example, piercing the four holes in the part shown in place.

Drill hole (1) in the die shoe, then drill hole (2) into the large hole and tap ⅛ or ¼ in. pipe tap as shown. Screw in a nipple and connect with hose to air supple. Make shouldered plug (3) with about 1/64 in. clearance and grind a flat on one side, as indicated by (4), and assemble.



The air ejector shown will eject screw machine products and other parts from dies in punch presses.

To operate, when the punch press has completed its stroke, a cam on the slide or crankshaft opens an air-valve, permitting a blast of air to enter hole (2). The blast of air will raise detail (3) sharply, lifting the part clear from the die. The clearance provided, as well as the flat, will permit enough air to by-pass the plug to blow the part clear from the die.

A. C. Good
Dayton Chapter, ASTE

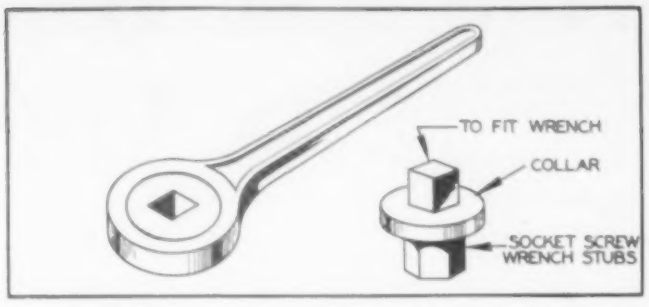
Salvaging Carbide Inserts

Solid carbide inserts, such as used with adjustable milling cutters and reamers, are ordinarily used to approximately half of their total length or width, whichever is the working dimension. They are then discarded, due to inability to hold them firmly in the cutter body.

In our plant, when the inserts need replacement, the old ones are placed in a bin marked with the grade, and from this stock of "raw material" we are able to make many special cemented carbide bits for production work in addition to developing cutters for new jobs.

Stanley R. Welling,
Racine, Wisconsin.

Ratchet Wrench for Socket Screws

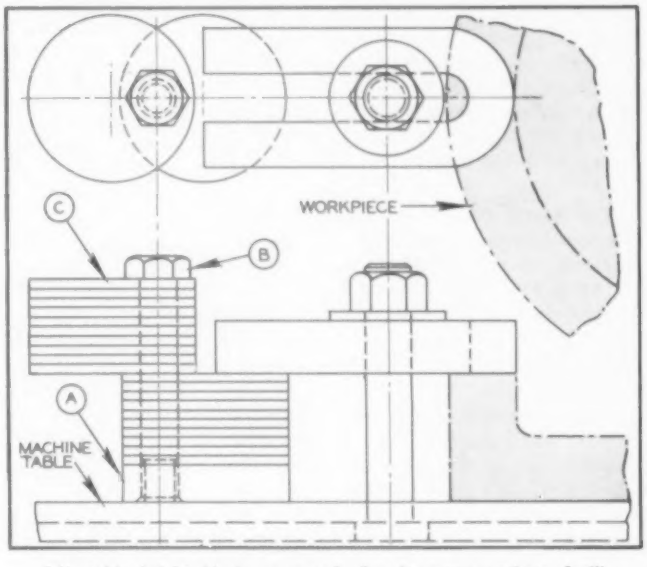


Stubs from socket head screw wrenches are welded to stubs to fit a small ratchet wrench.

The wrenches ordinarily furnished for socket head screws require considerable fumbling when tightening or loosening screws. Thus, considerable time is lost when a number of screws are involved. By purchasing a short ratchet wrench and welding on stubs of the various socket head wrenches to stubs fitting the wrench, the screws can be quickly tightened or removed without lifting the wrench from the slots.

George Hull
Detroit, Mich.

Adjustable Height Block



Adjustable height block, composed of swing-away washers, facilitates setup and provides closely parallel clamping.

The height block illustrated will be found highly useful in the shop for clamping work on the tables of milling machines, planers, drill presses and other machine tools. It will replace makeshift scrap blocks, which must be hunted up, and which have an uncanny way of disappearing just when needed.

The block consists of a round plate, (A), which has an eccentrically located tapped hole into which the bolt (B) is threaded, and then peened over on the end. Strung on this bolt are a number of ⅛ in. thick washers, (C), all of which have eccentrically located holes, drilled for clearance fit on the bolt B.

In use, the assembled unit is placed on the machine table. The height at which the clamp must bear on the workpiece is ascertained, and all washers beyond this height are then swung out of the way, as shown. The clamp will then lie closely parallel with block and workpiece. If so desired, a stud can be substituted for the bolt, in which case a nut can be used to retain the washers. In any event, a set of these height blocks, kept handy in the tool box, will both save time and provide safer setups.

J. P. Paquin,
Worcester, Mass.

North East West South IN INDUSTRY

W. J. Long and **William G. Stewart** have been elected vice presidents of **Universal-Cyclops Steel Corp.** Mr. Long was formerly manager of tool steel sales, while Mr. Stewart was until recently assistant secretary of the company.

Elmes Engineering division of American Steel Foundries has recently moved from its former Chicago headquarters to a new plant at 1150 Tennessee Ave., Cincinnati.

Greenfield Tap and Die Corp. has announced removal of their **Ampco** twist drill manufacturing facilities from Jackson, Mich., to Greenfield, Mass., with completion of the move expected by Sept. 1. Corporate structure of the Ampco Corp. has been dissolved, and its president, **Frank J. Sikorovsky,** becomes a vice president and director of Greenfield Tap and Die Corp.

The **South Wind** division of **Stewart-Warner Corp.** has recently entered into the custom production of finished machine parts, it has been announced by the company. **A. J. Frieling** has joined the company as field sales representative.

Parker Manufacturing Co., Worcester, Mass., has acquired the **Ackerman-Steffan Co.,** of Chicago, manufacturers of saw blades and frames. The new division will continue production at its present location.

E. H. Remde, formerly works manager, has been appointed advisor to the president of the Industrial Truck division of **The Baker-Raulang Co.** At the same time **H. A. Schultz,** formerly superintendent, was made manufacturing engineer; and **I. L. Young** was named general superintendent.

Gen. Brehon Somervell, president of Koppers Co., Inc., has been named to the board of **The Carborundum Co.** at a recent meeting of the board.

F. M. Urban has been appointed sales manager of engineered rubber products, and **H. Leon Moran,** factory manager of the Fort Wayne plant of **United States Rubber Co.**

Threadwell Tap & Die Co., Greenfield, Mass., has announced the purchase of the **Conant & Donelson Co.,** Conway, Mass. Production has been transferred to the Threadwell plant.

Several recent changes in its organization have been announced by **The Fellows Gear Shaper Co.,** Springfield, Vermont.

Cecil M. Peter, formerly general sales manager, becomes vice president and general manager. **Leroy C. King,** former Eastern manager, was named sales manager. **Herbert W. Nickerson** succeeds Mr. King as Eastern manager. **George Sanborn** was named Detroit manager as well as chief field engineer, with **Carl Rice** as assistant. Representatives include **Fred Pauling,** New York; **Ralph Lane,** Boston; **Ralph Aiken,** Syracuse; **Frank Sanborn,** Los Angeles.

Winner of the recent **Morse Twist Drill** contest to find a name for a new Morse drill is **Robert B. Ketterer** of Karl Lieberknecht, Inc., Reading, Pa. The contest was advertised in this and other trade papers, and the name submitted by Mr. Ketterer was "Ambore".

Coming Meetings

Sept. 9-12, **Instrument Society of America;** clinic on maintenance of industrial instruments. Hotel Statler, St. Louis.

Sept. 26-28, **National Electronic Conference;** conference and exhibition. Edgewater Beach Hotel, Chicago.

October 17-21, **American Society for Metals;** annual meeting. Cleveland. (**National Metal Congress,** concurrently, Cleveland Public Auditorium)

October 17-21, **American Welding Society;** annual meeting. Cleveland.

October 17-21, **American Institute of Mining and Metallurgical Engineers;** fall meeting. Cleveland.

October 17-21, **Society for Non-Destructive Testing;** annual meeting. Cleveland.

October 27-29, **American Society of Tool Engineers;** Seventeenth Annual Meeting. Mount Royal Hotel, Montreal, Quebec. (H. M. Windsor, ASTE, 10700 Puritan Ave., Detroit 21, for reservations.)

Harry R. Reynolds has been appointed consulting engineer, and **Howell L. Potter** chief engineer of **The Fafnir Bearing Co.,** New Britain, Conn. Mr. Reynolds, former chief engineer, has been with the company since its inception in 1911.

E. F. Allison has been named field sales and service manager, a new post, for **Fansteel Metallurgical Corp.** He will operate from the North Chicago, Ill., headquarters of the company.

The Sturgis Products Co., Sturgis, Mich., manufacturers of mechanical finishing equipment, has changed its name to the **Roto-Finish Co.,** and has moved its sales and manufacturing activities to its new plant at Kalamazoo, Mich.

Stanley E. Peterson has been named vice president and secretary, and **Walter E. Beaney** vice president and factory manager of **The Whiton Machine Co.,** New London, Conn.

A. A. Cambria has been appointed director of sales of **Progressive Tool and Die Co.,** Worcester, Mass. A former chief engineer of Lapointe Machine Tool Co., Mr. Cambria was more recently district manager for U. S. Broach Co.

Arthur E. Focke, research metallurgist for the Diamond Chain Co., will take office October 19 as the next president of the **American Society for Metals,** it has been announced by W. H. Eisenman, executive secretary.

John J. Radigan, formerly assistant director of personnel, has been named director of industrial relations of **E. W. Bliss Co.** Mr. Radigan has been associated with Bliss since 1946.

Leonard G. Daniels has been named metallurgist on the staff of **Precision Metalsmiths, Inc.,** Cleveland. Mr. **Daniels** is a graduate of Case Institute of Technology.

OBITUARIES

Harold C. Bullard, plant engineer and member of the board of directors of **The Bullard Company,** died recently. Mr. Bullard, with the company for 45 years, was the son of the founder.

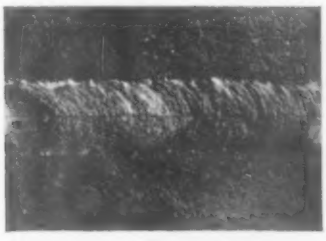
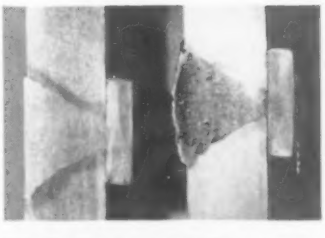
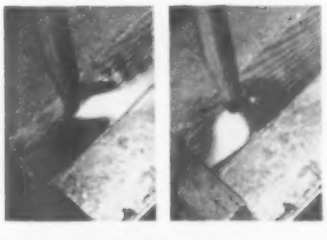
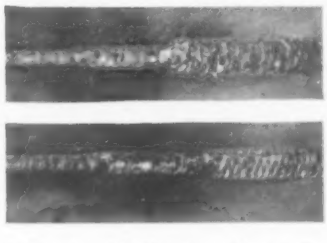
Harold C. Bullard **Edwin C. Shultz**

Edwin C. Shultz, advertising manager of the **Pratt & Whitney** division, Niles-Bement-Pond Co., died recently after a short illness. Mr. Shultz joined Pratt & Whitney in 1922, shortly after that became associated with the advertising department.

TOOL ENGINEERING DATA

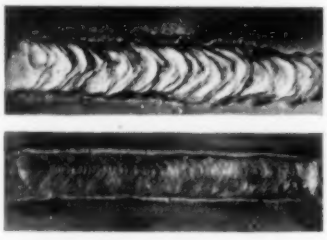
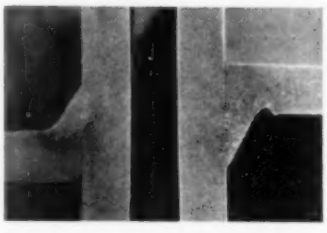
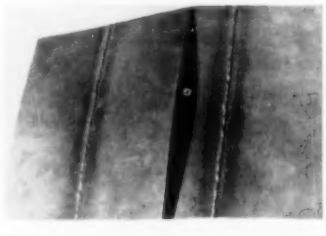
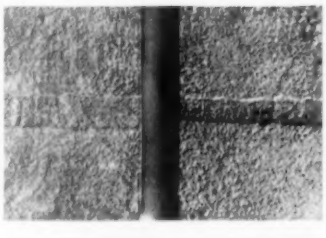
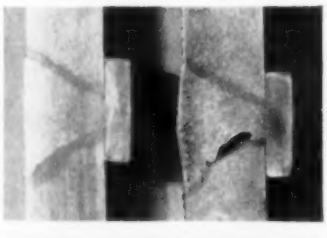
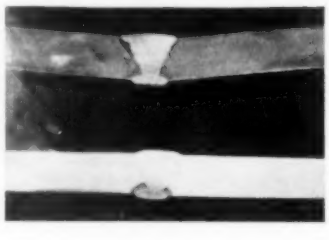
NUMBER EIGHT

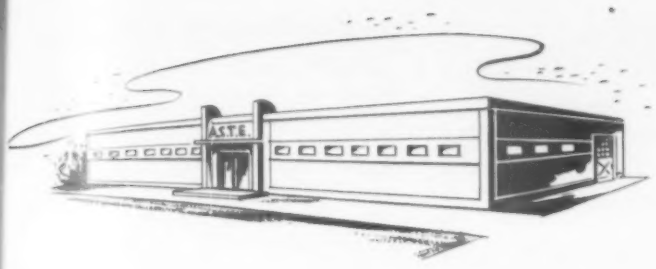
Causes and Cures of Some Common Weldiug Problems

PROBLEM		CAUSE	CURE
CRACKED WELDS Cracked weld caused by rigid joint.		(A) Joint too rigid. (B) Welds too small for size of parts joined. (C) Poor welds. (D) Improper preparation of joints. (E) Improper electrode.	A. Design the structure and develop a welding procedure to eliminate rigid joints. B. Do not use too small a weld between heavy plates. Increase the size of welds. C. Do not make welds in string beads. Make welds full size in short section 8 to 10 in. long. D. Welding sequence should be such as to leave ends free to move as long as possible. E. Insure that welds are sound and the fusion is good. F. Preheating parts to be welded is sometimes helpful. G. Prepare joints with a uniform and proper free space. In some cases, a free space is essential. In other cases, a shrink or press fit may be required.
BRITTLE JOINTS Ductile and brittle joints.		(A) Air hardening base metal. (B) Improper preheating. (C) Unsatisfactory electrode.	A. When welding on medium carbon steel or certain alloy steels, the heat-affected zone may become hard as a result of rapid cooling. Preheating at 300-500 deg F should be resorted to before welding. B. Multiple layer welds will tend to anneal hard zones. C. Annealing at 1100-1200 deg F should be done after welding and will generally soften hard areas formed during welding. D. The use of austenitic electrodes is sometimes desirable on steels which harden readily. Increased weld ductility compensates for the brittle, heat-affected area in the base metal.
INCOMPLETE PENETRATION Incomplete penetration on vee-butt joint.		(A) Improper preparation of joint. (B) Use of too large an electrode. (C) Insufficient welding current. (D) Too fast a welding speed.	A. Be sure to allow the proper free space at the bottom of a weld. B. Do not expect excessive penetration from an electrode. C. Use small diameter electrodes in a narrow welding groove. D. Use sufficient welding current to obtain proper penetration. Do not weld too rapidly.
WELDING STRESSES Lines radiating from the weld are located where the mill scale has cracked off the plate because the residual stresses produced by the weld shrinkage have exceeded the yield point of the material.		(A) Joints too rigid. (B) Improper welding sequence. (C) Inherent in all welds, especially in heavy parts.	A. Slight movement of parts during welding will reduce welding stresses. B. Make weld in as few passes as practical. C. Peen each deposit of weld metal. D. Anneal finished product at 1100-1200 deg F for one hour per inch of thickness. E. Develop welding procedure that permits all parts to be free to move as long as possible.
POROUS WELDS (LEFT) Sound butt weld. (RIGHT) Porous butt weld caused by short arc and insufficient puddling.		(A) Inherent property of some electrodes. (B) Not sufficient puddling time to allow entrapped gas to escape. (C) Poor base metal. (D) Too short an arc length.	A. Some electrodes inherently produce sounder welds than others. Be sure the proper electrodes are used. B. Puddling keeps the weld metal molten longer and often insures sounder welds. C. Do not use excessive welding currents. D. A weld made of a series of strung beads is apt to contain minute pin holes. Weaving will often eliminate this trouble. E. In some cases, the base metal may be at fault. Check this for segregations and impurities. F. Do not hold too short an arc.
ARC BLOW (LEFT) Arc blow at end of joint. (RIGHT) Arc blow controlled by use of a magnetic shunt block of steel at end of joint.		(A) Magnetic fields cause the arc to blow away from the point at which it is particularly noticeable with d-c at ends of joints and in corners.	A. Proper location of the ground on the work. Placing the ground in the direction the arc blows from the point of welding is often helpful. B. Separating the ground in two or more parts is helpful. C. Weld toward the direction the arc blows. D. Hold a short arc. E. Change magnetic path around arc by using steel blocks. F. Use a-c welding.
IRREGULAR QUALITY (TOP) Poor vertical weld, improper electrodes and welding technique. (BOTTOM) Good vertical weld, proper electrode and current, and electrode manufacture.		(A) Improper electrode manipulation. (B) Excessive welding current. (C) Welding in improper position which electrode is designed. (D) Improper joint design.	A. Use a uniform weave or rate of travel at all times. B. Do not used. B. Avoid excessive welding currents. C. Use a uniform weave type of weld and the position in which the weld is to be made. D. Prepare all joints properly.

—Data Courtesy Westinghouse Electric Corporation

Causes and Cures of Some Common Welding Problems

PROBLEM		CAUSE	CURE
POOR SURFACE APPEARANCE (TOP) Weld with poor surface appearance caused by excessive welding current and improper weave. (BOTTOM) Weld with good surface appearance.		(A) Improper current and arc voltage. (B) Overheated work. (C) Poor electrode manipulation. (D) Inherent characteristics of electrode used.	A. Insure the use of the proper welding technique for the electrode used. B. Avoid excessive welding currents. C. Use a uniform weave or rate of travel at all times. D. Select proper electrode.
UNDERCUTTING (RIGHT) Undercut on fillet weld. (LEFT) Good fillet weld with complete penetration, flat face and no undercut.		(A) Excessive welding current. (B) Improper manipulation of electrode. (C) Attempting to weld in a position for which the electrode is not designed.	A. Use a moderate welding current and do not try to travel too rapidly. B. Do not use too large an electrode. If the puddle of molten metal becomes too large, undercut may result. C. Excessive weaving causes undercut, consequently should not be used. D. A uniform weave will aid greatly in preventing undercut in butt welding. E. If an electrode is held too near the vertical plane when making a horizontal fillet weld, undercut may be obtained on the vertical plate.
SPLATTER (LEFT) Weld made with proper current and arc length. Note absence of adhering splatter. (RIGHT) Weld made with excessive current and arc lengths. Note excessive splatter and poor appearance.		(A) Inherent property of some electrodes. (B) Excessive welding current for the type or diameter of electrode used. (C) Excessively long arc. (D) Arc blow.	A. Select proper type of electrode. B. Do not use excessive welding current. C. Hold proper arc length. D. Reduce arc blow. E. Paint parts adjacent to weld with whitewash. This prevents spalls from welding to parts and makes removal easy.
WARPING (THIN PLATES) (LEFT) Warped thin plate—improper tacking and welding procedure. (RIGHT) This plate free from warping—properly tacked clamped, welded by skip and slip-back method.		(A) Shrinkage of deposited weld metal. (B) Excessive local heating at the joint. (C) Improper preparation of joint. (D) Improper clamping of parts.	A. Select electrode with high welding speed and moderate penetrating properties. B. Weld rapidly to prevent excessive local heating of the plates adjacent to the weld. C. Do not have excessive spaces between the parts to be welded. D. Properly clamp parts adjacent to the joint. Use back-up to cool parts rapidly. E. Use special welding sequence; step back or skip procedure. F. Peen joint edges slightly before welding. This elongates edges and the weld shrinkage causes them to pull back to the original shape.
CORROSION (LEFT) Corrosion of welded joint (HNO_3). Note weld is equal or superior to parent metal. (RIGHT) Improper electrode causes poor corrosion resistance of weld (HNO_3).		(A) Type of electrode used. (B) Improper weld deposit for corrosive media. (C) Metallurgical effect of welding. (D) Improper cleaning of weld.	A. Bare-type electrodes produce welds that are less resistant to corrosion than the parent metal. B. Shielded arc-type electrodes produce welds that are more resistant to corrosion than the parent metal. C. Certain materials such as aluminum require careful cleaning of all slag to prevent corrosion. D. Do not expect more from the weld than you do from the parent metal. On stainless steels use electrodes that are equal or better than the base metal. E. When welding 18-8 austenitic stainless steel be sure the analysis of the steel and electrode does not cause carbide precipitations. This condition can be corrected by annealing at 1800-2100 deg F.
POOR FUSION (LEFT) Good butt weld with complete fusion and penetration. (RIGHT) Butt weld with poor fusing and slag inclusions on side, improper weaving procedure and low welding current.		(A) Improper diameter of electrode. (B) Improper welding current. (C) Improper preparation of joint. (D) Improper welding speed.	A. When welding in narrow vees, use an electrode small enough to reach the bottom. B. Use sufficient welding current to deposit the metal and penetrate into the plates. Heavier plates require higher current for a given electrode than light plates. C. Be sure the weave is wide enough to melt thoroughly the sides of a joint. D. The deposited metal should tend to sweat onto the plate and not curl away from it.
DISTORTION (TOP) Angular distortion obtained with single vee-butt joint not properly prepared or clamped. (BOTTOM) Single vee-butt joint free from angular distortion accomplished by proper clamping.		(A) Shrinkage of deposited metal pulls parts together and changes relative positions. (B) Improper welding sequence. (C) Non-uniform heating of parts during welding.	A. Properly clamp or tack parts to resist shrinkage. B. Preform parts sufficiently to compensate for shrinkage of welds. C. Study structure and develop a definite sequence of welding. D. Distribute welding to prevent excessive local heating. Preheating desirable on some heavy structures. E. Removal of rolling or forming strains before welding is sometimes helpful.



Members Share Personally In Financing of New ASTE Headquarters

Cooperate Generously to Release Society Funds for Other Projects
Interest-Bearing Certificate Offering To Be Withdrawn August 31

MEMBERS REPRESENTING every professional and financial stratum have demonstrated their faith in the American Society of Tool Engineers by already subscribing (at press time) more than $75,000 of a $110,000 issue of Building Fund Participation Certificates.

Still available through this month, the debentures are offered in connection with the financing of the new, cinder block Society headquarters office building constructed in the northwest section of Detroit last year.

The one-story, 12,000 square-foot structure is of functional design with modern lighting, heating and air conditioning equipment. Details of the building features were reported in the July and November, 1948, issues of *ASTE News*.

Pays Dues

Yielding 4½ percent interest per year, not compounded, for a term of 10 years, the certificates make an attractive investment, available only to Society members and chapters.

A $300 certificate, for example, will pay membership dues for 10 years, purchase a copy of the new "Tool Engineers Handbook" and a season dinner ticket for chapter meetings. This is a considerably higher return than savings bank deposits or other relatively liquid investments earn.

In order that participation may be widespread, purchases are limited to $10,000 per subscriber. The certificates are redeemable at any time after one year following date of issue, as authorized by the Board of Directors, and are transferable only to other members or chapters of ASTE. Interest begins on issuance, the 20th of the month following date of application.

The certificates may become a part of the subscriber's estate, since they may be held by him and his wife as "joint" tenants with right of survivorship—not as tenants in common.

Guaranteeing them with all its assets, the Society stands back of these certificates, but the obligations "do not constitute a lien or encumbrance upon any specific asset or upon the Society property as a whole."

Unfortunately currency restrictions abroad prevent other than United States citizens residing in foreign countries from participating in this issue, due to the present world scarcity of America dollars.

Deadline Near

August 31 is the last opportunity to take advantage of this profitable investment. A license extension will not be requested, as the Board of Directors feels that sufficient funds will have been subscribed when the present permit expires on that date.

Mail Application Now

For convenience in applying for the remaining certificates during the short time the offer is still open, use the subscription agreement form below. Application and remittance in United States funds should be mailed at once to: American Society of Tool Engineers, Department 8, 10700 Puritan Ave., Detroit 21, Mich.

Your money will do double duty—pay you profits and help your Society.

Please Enter My
SUBSCRIPTION AGREEMENT *for*
A.S.T.E. Building Fund Participation Certificate(s)

The undersigned hereby subscribes for _____ Dollars of A.S.T.E. Building Fund Participation Certificate(s), the same to be issued in denominations of _____ Dollars (even hundreds) each, and herewith tenders the sum of _____ Dollars in lawful money of the United States of America in full payment for the same.

Issued to _____ (full legal signature)
Street Address _____
If wife is to be joint tenant, enter her name below:
_____ (given name as: Mary Elizabeth Brown)
Dated at _____ (city) (state)
this _____ day of _____ A. D. 1949

To be filled in by subscriber

To be filled in by Society

Accepted at Detroit, this _____ day of _____ 1949
AMERICAN SOCIETY OF TOOL ENGINEERS
By: _____

(See conditions on reverse side.)

Our Society

By HARRY E. CONRAD, *Executive Secretary, ASTE*

THE HANDBOOK Is now a concrete reality—not that it hasn't always been, particularly to those on the Handbook Committee—but now we all can actually see it and, for the first time, actually have one of our very own. Nothing intangible to talk about any more, it's on the market and is being accepted far and beyond our most optimistic hopes.

I call the publishing of the Handbook a Society accomplishment wherein every member of the Society will profit and, certainly, every member can share in the Handbook Committee's justifiable pride in the finished work.

Five years of hard work have gone into the making of the Handbook. Many times, the committee was faced with what appeared to be insurmountable obstacles—each time, they put their heads together and came up with the right answer—no little task in itself I can assure you. All of the hard work, all of the planning and cooperating that has made the Handbook possible, will in a short time be but a memory in the minds of the committeemen who have done their work so well. However, there is one consolation, or perhaps a better name for it would be "a reward." They have created and contributed to the technical literature of the Society in such a fundamental manner that as long as there shall be a Society, their efforts will have made a lasting contribution to the future of the American Society of Tool Engineers.

To this end then, I am sure the entire membership joins me in saying a humble and sincere "thanks" to Ed Ernst and his committee of Frank Curtis, Bob Douglas, Ben Brosheer, Harry Crump, Frank Martindell, Ade Potter and last but not least, Frank Wilson, who has been the Handbook editor-in-chief since its inception.

BUILDING CERTIFICATE SUBSCRIPTION CONDITIONS

4½ Percent Interest Annually

It is understood that said certificates are part of an issue of $110,000.00 bearing interest at 4½ percent per annum, not compounded, commencing on the date of issue which will be the 20th of the month next following the date of this subscription, said interest to be paid to the registered holder of said certificates on the first day of the month prior to the month in which the due date of the interest falls.

Liquid Investment

It is also understood that said certificates are issued for a term of ten years but are redeemable at the discretion of the Board of Directors of the American Society of Tool Engineers at any time after the expiration of one year from and after the date of issue.

Only to Members and Chapters

It is also understood that said certificates will not be sold and are not transferable except to members or chapters of the A.S.T.E. and such transfers will be recognized only when properly verified and entered upon the records of the A.S.T.E. at Detroit, Michigan, and further that no member or chapter may own, hold or possess certificates in excess of $10,000.00 face value.

It is also understood that this subscription is subject to acceptance by the A.S.T.E. at Detroit, Michigan, and that all certificates are issued and sold at Detroit, Michigan, and that no subscription in excess of $10,000.00 will be accepted.

Guaranteed by All Society Assets

It is also understood that said certificates are guaranteed by the full faith and credit of the American Society of Tool Engineers but do not constitute a lien or encumbrance upon any specific asset of the Society or upon its property as a whole.

(See application form on reverse side.)

Ladies Night at Windsor

Windsor, Ont.—More than 250 people turned out on one of the hottest nights of the season for the annual Ladies Night of Windsor chapter, June 3, at Lakewood Golf and Country Club.

Fun and fellowship prevailed at this informal affair which grows in popularity from year to year. Following dinner, door prizes ranging from electric kettles to lawn mowers, cigarette lighters and car heaters were awarded to the holders of 36 lucky numbers.

W. A. Thomas, chapter chairman, spoke briefly, explaining to the ladies the aims and activities of the Society.

Remainder of the evening was spent dancing to Earl Simpkins' orchestra.

Coins ASTE Slogan

Richard Carter (left) of Windsor chapter shows Leonard Wortley, public relations chairman, suggested ASTE slogan he originated. Mr. Carter got the idea when he saw a container marked "Waste" turned so that the "W" was nearly obscured.

Members Deluge Society With Handbook Orders

Detroit, Mich.—Three weeks before the "Tool Engineers Handbook" was scheduled for publication, more than 2000 orders had poured into ASTE headquarters. These are exclusive of copies ordered directly from the publisher by buyers outside the Society.

A special price of $11 is available to each member for one personal copy ordered through ASTE headquarters. Regular list price for the manual published late last month is $15.

The heavy advance sale indicates that the Handbook will be a "must" in technical libraries of the majority of the membership.

For the convenience of members who did not order their copies of the Handbook last month, the handy coupon form is being reprinted in this issue on page 55. When filled out, these forms should be returned to: American Society of Tool Engineers, Dept. 7, 10700 Puritan Ave., Detroit 21, Michigan.

From his high perch in Place d'Armes, Maisonneuve, founder of Montreal, surveys Notre Dame Cathedral, fifth successor to first place of worship built inside fort he erected. Below, top, left: An old-world caleche pauses on the way up Mount Royal to give visitors a view of lovely Lac Castor. Right: Sailors Institute in Old Place Royal is a reminder of the city's maritime importance. Center: For more than a century worshippers have prayed in Notre Dame de Bonsecours for the safety of seafarers. Lower left: Foot traffic in Dominion Square flows around the monument to Sir John A. MacDonald, one of the Fathers of Confederation. Right: The majestic St. Lawrence has seen Montreal grow from an Indian village to a modern city.

Charm of French Canada Awaits ASTE at Montreal

Fall Convention Host Contrasts Old and New Worlds

WHEN ASTE members and their families visit bilingual Montreal for the Society's 17th semi-annual meeting, October 27, 28, 29 they will experience the unique sensation of being overseas on their own continent.

Third largest French city in the world, the Dominion's major metropolis gracefully combines Old World culture and modern living. Since the first white man discovered an Indian village there in 1535, it has become one of the great industrial, commercial, shipping and tourist centers of North America.

Its million inhabitants, predominately of French origin mingled with those of British and other extractions, give it a cosmopolitan atmosphere.

Harnessing nearby power resources has made it a natural manufacturing site. Its position as the world's largest inland port, 1000 miles from the sea, has established it as a busy center of international trade and a shopper's paradise.

The sightseer delights in exploring landmarks that tell the story of its past, ancient churches, imposing monuments and a rambling mountain park overlooking the city.

For the tool engineer it affords opportunity to learn tricks in tooling for short run production to compete with mass manufacture. A number of important plants will open their doors to the Society; well known speakers will contribute one of the best technical programs the Society has ever presented, including a scoop on a brand new process.

Full details of the entire convention program, with banquet and hotel reservation forms, will appear in a special convention section of the September *Tool Engineer*. Meanwhile, reserve that last weekend in October for ASTE at Montreal.

Armagost Heads Columbus Chapter Officer Group

Men who will direct Columbus chapter affairs for the 1949-50 season are, from left: W. Kenneth Armagost, chairman; Thomas F. Starkey, first vice-chairman; Milner D. Sherman, second vice-chairman; E. J. Kellogg, secretary; and John E. Mitchell, treasurer.

Earth Moving Equipment Plant Host to T. E.'s

Evansville, Ind.—Bucyrus-Erie Co. was host to 60 members of Evansville chapter for a tour of the local plant, June 13.

Assembling at the cafeteria, the tool engineers were guests at dinner before starting the trip. James Jourdan, company vice-president in charge of industrial relations, was in charge of the tour, assisted by Vincent Snyder and Harry Small, who guided the group through the operations for making large dip shovels, draglines, bulldozers and other earth moving equipment.

The ASTE men saw how large, heavy pieces of steel are handled in processing. The tour led through forge and machine shops, heat treat and welding departments, final assembly and proving grounds.

E. E. Rhoades, of Vulcan Tool Co. and a member of Dayton chapter, was a guest for the tour.

Loeppert Called by Navy

Chicago, Ill.—H. Verne Loeppert, vice-president of Boyd-Wagner Co. and treasurer of Chicago chapter, ASTE, has been ordered to active duty with the U.S. Navy. Now associated with the Naval Air Reserve training program, Lieutenant Loeppert served as an electronics officer during the last war.

Lieutenant Loeppert will attend the economic mobilization course being offered in Chicago by the Industrial College of the armed forces. The course deals with problems in economic and industrial mobilization in time of national emergency. The Chicago chapter officer was instrumental in gathering and disseminating such information through his company at the beginning of World War II.

GET ONE *Tool Engineers Handbook**

*2000 pages of basic tool engineering information. Price to members only, $11.

WSE Invites ASTE To Use Headquarters

Chicago, Ill.—Through its affiliation with the Western Society of Engineers, the Chicago ASTE chapter now holds its meetings at Western Society's attractive new headquarters at 84 E. Randolph St. Western Society, according to Thomas C. Barber, first vice-chairman of the local ASTE group, has extended the use of its rooms to visiting members of this Society.

The central, downtown location, he points out, makes it a convenient rendezvous for business or social engagements or to while away a few hours between transportation connections. Facilities include moderately priced luncheon and dinner service, an excellent bar and lounge.

Everyone Wins Prize At Annual Outing

Erie, Pa.—Erie chapter held its third annual picnic, June 19, at General Electric picnic grove, with 70 members and guests attending.

Main event of the day was the softball game in which the "Almighty Peddlers" trimmed the "Slide Rule Jockies" 29-17. It was J. Pasick and Walter Cebelinski for the victors and Harry Rudd and Stanley Sadoski for the losers.

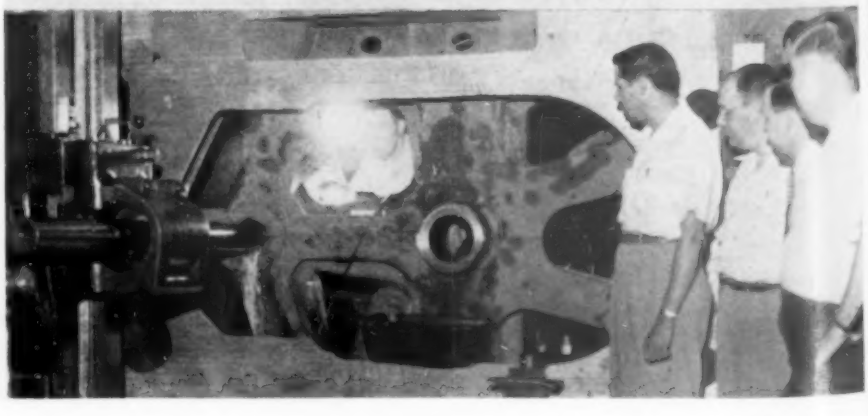
Prize winners at games were as follows: Nail driving, W. J. Koch, first, and W. A. Mieszczak, second; horseshoe ringers, William Vargo, six, Ralph Alexander, five, and James Linhart, five; nuts in a jar, J. P. Vogel; size of a metal stamping, William O'Neil; darts, Ralph Alexander, first, and Dr. Wilkos, second; egg tossing (team), Adam Konopka and Stanley Prohoski; weight of a casting, William Mieszczak.

A contest to guess the size of a ball bearing ended in six ties. The tug-of-war was close, but the "West" finally overpowered the "East."

Everyone received an attendance prize and the six draw prizes went to the following: Percy Mayo, a guest, portable radio; William Snook, "Tool Engineers Handbook;" George Pease, casting rod and reel; Vincent Peck, pocket slide rule; William Vargo, a guest, three-inch vise; and James Linhart, electric soldering iron. Chairman Archie Weingard supervised the drawings.

A picnic lunch featured an ox roast.

Arrangements for Evansville chapter tour of Bucyrus-Erie Co. plant were handled by (top) from left: Roy Ackerman, Servel, Inc., program chairman; Walter Schneider, also of Servel, chapter chairman; Vincent Snyder, James Jourdan and Harry Small of Bucyrus-Erie; Edward Rhoades, Vulcan Tool Co.; and Clarence Barton of Servel. Below: Watching boring of main frame casting for a 10-yard shovel, on a horizontal boring mill are, from left: Maurice Paris of Servel, Walter Glesige, Benerson Corp.; Bernard Pampe, Seeger Refrigerator Co.; and Roy Ackerman of Servel.



Blackall Tells Hartford Of European Dilemma

Hartford, Conn.—"Hartford Night," the annual closing function of the season for Hartford chapter, was observed June 6 at Hotel Bond, with more than 350 members in attendance.

Principal speaker was Frederick S. Blackall, Jr., president-treasurer of Taft-Peirce Manufacturing Co., Woonsocket, R. I., who related his impressions of European conditions as he found them while visiting the British National Machine Tool Exhibition at London and industrial areas on the continent.

The English show Mr. Blackall estimated as comparable in size with the last NMTBA exhibit in this country, but more nearly international in scope since manufacturers from other countries were represented.

The display, he commented, showed extensive research and development on the part of British machine tool builders and remarkable progress during the past decade; also "blatant pirating" of American machine tool designs.

Cannot Buy American Tools

Explaining the English predicament, he stated that manufacturers there must export a stipulated percentage of production in order to secure raw materials. Clinging to reciprocal trade agreements, Britain exchanges finished goods for food stuffs and raw materials. American machines and tools are excluded since imports of manufactured products are limited to those for which there is no approximate, domestic substitute.

Mr. Blackall expressed admiration for Swiss tools and machines and the excellence of the finishes they obtain with standard equipment. Installation of inspection equipment is comparable to a seismograph setup and is located below ground to avoid vibration.

In Sweden, the speaker discovered, plants get higher production with Swedish machines than with their best American equipment. Here, too, inspection is carried out with "loving care."

Spokesmen for companies in Sweden and other European countries told Mr. Blackall that they want to buy American machinery and that they have the money, but they cannot get dollars from their governments.

America's problem, he pointed out, is to control expenditure of foreign financial aid without seeming to interfere with the internal affairs of friendly nations.

Guests at the dinner included Society President R. B. Douglas of Montreal.

GET ONE *ASTE Building Fund Participation Cerificate**

*The 4½% interest on a $300 certificate will pay your annual ASTE dues, purchase a "Tool Engineers Handbook" and leave money for other things.

Frederick S. Blackall, Jr., president-treasurer of Taft-Peirce Mfg. Co., and R. B. Douglas, Society president, meet at "Hartford Night" function where Mr. Blackall was principal speaker. From left: Donald B. Huntting, first vice-chairman; Mr. Blackall, Clayton S. Parsons, chairman; Mr. Douglas, and John E. Allen, advertising manager of the Fuller Brush Co., who was toastmaster.

Hy-Pro Promotes Smith

New Bedford, Mass.—Robert A. Smith of Little Rhody chapter, ASTE, has been promoted to sales manager of Hy-Pro Tool Co., the firm has announced.

Mr. Smith joined Hy-Pro as an engineer upon his release from the armed forces. Three years later he was transferred to the sales department and has been working in the field until his recent promotion.

Prior to the war Mr. Smith served an apprenticeship and worked as an engineer and designer with Fellows Gear Shaper Co. of Springfield, Vt., and Continental Screw Co. of New Bedford.

Countess Addresses Cincinnati Dinner

Cincinnati, Ohio—Cincinnati chapter held its eleventh annual dinner recently at Hotel Alms Ballroom.

Following a social hour and dinner, George Simon, retiring chairman, reported on the year's activities. Henry Bruewer, incumbent chairman, presented a past chairman pin to Mr. Simon and introduced new officers.

The guest speaker, Countess Maria Pulaski, held the 130 members and guests spellbound with revelations of her experiences in the British intelligence service.

Dancing and the awarding of door prizes climaxed the evening.

Prominent at Cincinnati chapter's recent annual dinner were, top, from left, seated: George Simon, retiring chairman; Countess Maria Pulaski, guest speaker; Henry Bruewer, chairman; and G. A. Goodwin, national treasurer. Standing: Bertram Workum, treasurer; Edgar L. Routzong, second vice-chairman; George Bradley, first vice-chairman; and Howard N. Peters, secretary.

Research Plant Shows How It Cuts Product Cost

Chicago, Ill.—Ninety members of Chicago chapter were guests of the manufacturing research department of International Harvester Co. for a plant visitation, June 14.

Perry Hauser was host to the group and J. W. Armour, manager of the department, pointed out how manufacturing research differs from product research, and how it operates in relation to company plants throughout the country.

After dinner had been served to the visitors, they started the tour in three groups.

Stopping at the heat treat department, the engineers saw electric and gas fired furnaces for production heat treating and heard them explained by company guides. To demonstrate induction heating, the teeth of a transmission gear were hardened. Vapor blast equipment was shown deburring and preparing surfaces for lubrication.

Materials Tested Under Loads

In the section for testing materials under static and vibratory loads, the ASTE'ers watched a track link for a 450 hp tractor being tested for fatigue, and inspected a torque test setup for a tractor chain sprocket.

As they passed through the welding department, an employee described the operation of an 800 kva flash welder, a 600 kva projection welder, seam welders and spot welders.

A room with concrete walls 16 in. thick houses a 1,000,000-v X-ray machine. Here the tool engineers looked at pictures of case studies and observed a special X-ray camera, developed by the company, which shows the amount of retained austenite in steel. Another of their developments is an oscilloscope, adapted to record the current pressure and time relationships of a projection welder.

A spectroscope, pictures of metals, and several pieces of electrical testing equipment also were shown and discussed.

The chemical laboratory demonstrated how it had overcome corrosion in cotton picker spindles by applying lubricant containing a rust inhibitor, and the inorganic chemical laboratory ran tests on the composition of steels, alloys and other materials.

Through application of research to manufacturing problems, International Harvester has realized a substantial annual saving in costs, the visitors learned.

Swartz Details Hobbing Of Molds for Plastics

Binghamton, N.Y.—Meeting for the last time until fall, 82 Binghamton chapter members and guests heard C. K. Swartz, manager of development, Consolidated Molded Products Corp., Scranton, Pa., lecture informatively on plastics and molds. Mr. Swartz was technical speaker at a dinner meeting, June 14, at the American Legion Club.

After describing types of molds such as injection, positive, semi-positive, open flash, cam and center gate, Mr. Swartz explained the art of hobbing molds under heavy pressure. In this process a steel master pattern, duplicating the part to be molded, is impressed into the mold blank. The resulting cavity is finished to a high degree and the mold subsequently heat treated. A final polishing may be necessary after heat treating.

Samples of complicated molds and plastic products were displayed by Mr. Swartz to illustrate his talk.

Guests included 25 boys from the International Business Machines Apprentice School.

During the meeting the chapter voted to present copies of the "Tool Engineers Handbook" to technical students having the highest averages among the 1950 graduating classes at North and U.E. high schools.

D. J. Erlenmeyer, chapter chairman, presided and introduced the speaker.

Denver T. E.'s Visit Colorado Steel Plant

Denver, Colo.—Some 40 Colorado tool engineers from Denver chapter were recent guests of the Colorado Fuel & Iron Corp.'s Minnequa plant at Pueblo. Arriving at the plant at 8:30 a.m., the tool engineers were met by company safety supervisors who served as guides.

In the blast furnace department the group looked over the firm's pig iron production facilities. Continuing through various departments, the ASTE'ers saw the rail and rod mills and the open hearth.

After lunching at CF&I's Steelworks YMCA cafeteria, they proceeded to the wire mill and coke plant.

Clinton J. Helton, chapter program chairman, was in charge of all arrangements for the trip. J. R. Matthew, chapter chairman, accompanied the group.

The trip to the Pueblo plant was the second such tour arranged for chapter members. Plans are underway for visiting all major industrial concerns in the Rocky Mountain area.

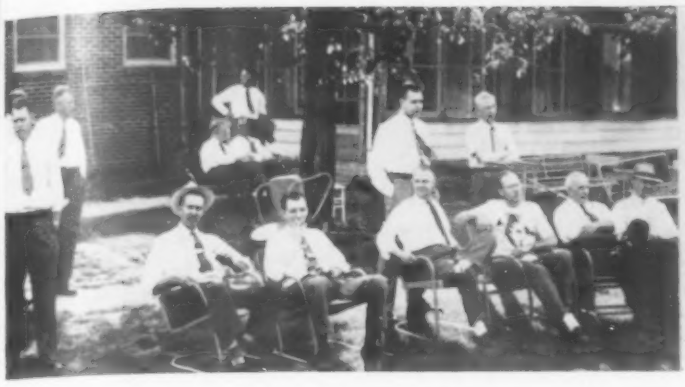
Joins Chicago-Latrobe

Detroit, Mich.—William B. Crump of Detroit chapter, ASTE, has joined the sales organization of Chicago-Latrobe as district manager of the Michigan industrial territory, with headquarters at 111 East Milwaukee St., Detroit.

Previously Mr. Crump represented an allied manufacturer in the cutting tool field for several years. Prior to that he served in various capacities from instructor to production engineer with leading producers in the automotive industry.

He is a graduate of Henry Ford Trade School, Lawrence Institute of Technology, and has taken graduate work at the University of Minnesota. He is also a member of SAE.

Denver tool engineers meet at the Pueblo plant of the Colorado Fuel & Iron Corp. for a tour of its steel making facilities.



Left: Taking things easy in the shade, these Rockford tool engineers watch golf fans (right) warm up for tournament at chapter outing.

d'Arcambal Receives Degree from U. of M.

Hartford, Conn.—A. H. d'Arcambal, vice-president and consulting metallurgist of Pratt & Whitney, Div. of Niles-Bement-Pond Co., West Hartford, was awarded the degree of Metallurgical Engineer by the University of Michigan during its June commencement exercises.

Although majoring in metallurgical studies during his undergraduate work at the university, he graduated in 1912 with the degree of Bachelor of Chemical Engineering—the only degree then conferred by U. of M. for this advanced type of study and research.

Through the intervening years, Mr. d'Arcambal has attained national and international prominence in various fields of metallurgical science. In 1941 he was cited by his Alma Mater for outstanding achievements in applying scientific methods to the problems of the metal working industry.

A member of Hartford chapter, ASTE, Mr. d'Arcambal is a past president of this Society and of ASM.

Norton Makes Transfers

Denver, Colo.—R. O. Anderson of Denver chapter, ASTE, has been transferred by Norton Co. from his Denver headquarters to St. Louis, Mo. There he will be manager of a newly established district including the previous Rocky Mountain and South Central territories and two areas formerly in the Chicago district.

H. G. Brustlin of the Baltimore ASTE chapter has been appointed abrasive engineer in charge of the Denver territory.

Appointed Sales Manager

New Haven, Conn.—J. H. Broderick, formerly chief inspector of Geometric Tool Co., a division of Greenfield Tap & Die Corp., has been appointed field sales manager, according to a company announcement.

Prior to 1935 when he joined Geometric, he was associated with the Locomobile Co. and the Bullard Co.

Mr. Broderick is standards chairman of New Haven chapter, ASTE, and a member of the New Haven Foremen's Club and the ASQC.

Kaiser Wins Low Net At Golf Tournament

Rockford, Ill.—Some 75 Rockford members and guests spent an afternoon golfing at the chapter's 13th annual summer stag, held June 10 at Mauh-Nah-Tee-See Country Club.

Chairman Comes Through

Karl Kaiser, chapter chairman, won low net, and a guest named Spineskie drew a golf bag for winning low gross.

A casting contest filled the interval between the golf tournament and dinner. Ties were so numerous that no prizes could be awarded. In horseshoe pitching Dean Cline carried off the honors, while Ray Anderson claimed first prize for skill at dart throwing.

Following dinner Chairman Kaiser distributed numerous attendance prizes. These included a radio, a coffee maker, a waffle iron and a leather bag. Don Hawkinson won a wrist watch, the grand attendance prize.

To be sure of having the first edition as soon as it comes from the bindery, mail the order coupon at the right today.

According to an announcement by Executive Secretary H. E. Conrad, each member is entitled to one copy of the Handbook at the special price of $11. Additional books may be purchased at the $15 list price.

Special arrangements are being made to facilitate deliveries in Canada and elsewhere outside the United States.

The profession is enthusiastic about this Handbook. Order your copy today.

Here's My Order

Please send my copy of the "Tool Engineers Handbook" to the address below, at the special, ASTE member price of $11.

Name ..... Chapter .....

Business Title ..... Firm Name .....

Street Address .....

City ..... Zone ..... State .....

Remittance payable to the Society must accompany order. Do not send currency. Mail this order coupon or a facsimile to: American Society of Tool Engineers, Dept. 7, 10700 Puritan Ave., Detroit 21, Mich.

Important—In order to obtain the $11 price, orders must be sent to the Society.

Long Distance Dialing To Speed 'Phone Calls

Toledo, Ohio—Seconds after you pick up your telephone and dial a number anywhere in the United States, you can start talking to your party, when the new long distance customer dialing system is completed, Robert Clark of the public relations department, Ohio Bell Telephone Co., Cleveland, informed Toledo members.

This and other improvements in telephone service, now in limited use or planned for the future, were described by Mr. Clark at a chapter meeting held recently at Toledo Yacht Club.

New voice highways already in partial operation, he said, will carry telephone traffic and television programs over coaxial cables and micro-waves. In demonstrating the micro-wave radio relay between New York and Boston, Mr. Clark showed how micro-waves could be reflected, bent, or concentrated into narrow beams.

Shows Pocket Telephone

Giving the audience another look into the future, the speaker displayed a pocket microphone and receiver, each no larger than a quarter, connected by a thin wire. A complete transmitting and receiving set, this telephone needs no external connections.

Other advances mentioned may make it possible to record messages on your home phone while you are away and to control the volume of the bell.

Mr. Clark's discussion included mobile radio-telephone service for moving vehicles, and "scrambled speech," a method of insuring privacy in trans-oceanic calls.

While demonstrating throat and lip microphones, widely used in wartime by the armed forces, Mr. Clark suggested peacetime applications such as in noisy factories.

Coming Meetings

CLEVELAND—September. Trip to Detroit Arsenal to see new General Patton tank.

MONTREAL—October 27, 28, 29. ASTE 17th Semi-Annual Meeting.

PHILADELPHIA—September, Broadwood Hotel. Executives Night.

WINDSOR—September 12, Prince Edward Hotel. Speaker: Wallace H. Clark, director of industrial relations, Ford Motor Co. of Canada, Ltd., Windsor, Ont. Subject: "Human Relations in Industry."

Situation Wanted

PRODUCTION ENGINEER—15 years' experience in aircraft and automotive manufacturing. Available at once, willing to move to new location. Background in management and production work. Please address replies to Box 173, American Society of Tool Engineers, 10700 Puritan Ave., Detroit 21, Mich.

Top: Police show-up? Nope, just "Officer" Mike Lopinski of the Philadelphia chapter Registration and Reception Committee surveying some of the fair sex at the annual chapter outing. Below: Balloon blowing contest takes a lot of wind.

Prizes Climax Outing

Philadelphia, Pa.—The third annual outing of Philadelphia chapter drew 415 members and their guests to the grounds of the Philadelphia Rifle Club, June 11.

The afternoon was spent in a quoits tournament, grove games, softball, golf chipping, and bingo. A well patronized snack bar helped sustain the players until the cocktail hour. During this interlude an accordionist entertained.

Following dinner, awards were presented to winners of the afternoon events, door prizes were distributed and a drawing was conducted for the grand prize, a Philco television receiver.

A six-act floor show concluded a day of pleasant diversion.

Former Students Join Rockford Firms, Chapter

Rockford, Ill.—John Floden, winner of the 1947 scholarship of Boston chapter, is now employed in Rockford as engineer and machine designer with Greenlee Bros. & Co.

While a student at Massachusetts Institute of Technology, the Rockford man was awarded the $100 prize for his thesis, "Effect of Cutting Fluids on Drilling Thrust and Torque."

Since graduating and returning to his home city, Mr. Floden has affiliated himself with the local ASTE chapter and is one of their most active members.

Another enthusiastic member of the Rockford group is A. Melvin Hann, formerly associated with the ASTE student chapter at Purdue University. Mr. Hann is connected with Sundstrand Machine Tool Co. as a hydraulic engineer.

Moving?

Tell us your new address so *The Tool Engineer* can go with you. Notify: American Society of Tool Engineers, 10700 Puritan Ave., Detroit 21, Mich.

Obituaries

Walter Candlin

Walter Candlin, an active member of Philadelphia chapter, ASTE, for many years, died June 25 at St. Agnes Hospital in that city. He succumbed to a heart attack with which he was stricken a week before, after apparently recovering from one suffered three months previously.

A native of England, Mr. Candlin was educated as a metallurgist at Sheffield University there. He came to this country more than 30 years ago as a representative of Sheffield Steel Co.

Terminating this connection he was employed by Franklin Motor Co. for a short time before becoming associated with Halcomb Steel Co. When this firm was absorbed by Crucible Steel Co., Mr. Candlin became a sales engineer for the latter concern, a position he had held for the past 20 years.

A member of the Philadelphia ASTE group since 1938, he had served on several chapter committees.

Harry Dulle

Harry Dulle, general foreman of Production Tool and Engineering Co., St. Louis, Mo., succumbed May 30 to an illness of about 10 weeks.

A native of St. Louis, Mr. Dulle had been associated with his firm since 1946. Prior to this connection he had been employed by National Slug Rejectors for three years and by Larkin-Packer Co. for 15 years. He was a member of the St. Louis chapter of ASTE.

Schlacter Transferred

Detroit, Mich.—Henry T. Schlachter of Cincinnati chapter, ASTE, has been appointed Detroit representative of Detroit Broach Co., succeeding Earl Hovey of Detroit chapter, who is retiring from the cutting tool field.

Mr. Schlacter was formerly associated with the Cincinnati office of Detroit Broach.

Multiple Molds Speed Plastics Production

Los Angeles, Calif.—"Tooling for Plastics with Beryllium Copper Die Inserts" was the topic of an informative talk by Milo Dellmann, president of Southgate Tool Engineering Co., Inc., at a meeting of Los Angeles chapter, June 9, in Roger Young Auditorium.

Displaying samples of dies, tools and plastic products and using a blackboard to illustrate mold design, Mr. Dellmann showed that multiple cavity molds are the secret of high production of molded plastic parts and products.

Unlike screw machines, he stated, injection molding machines are capable of only 120 strokes per hour on the average plastic job.

The speaker also illustrated the technique of using highly polished, hardened steel hobs to duplicate multiple cavity die inserts of molten beryllium copper.

As background for Mr. Dellmann's talk, a Tennessee Eastman Corp. film, "The Story of Tenite," was presented by R. K. Halliday, sales manager for Wilson and George Meyer & Co., Los Angeles.

Milo Dellmann (at microphone) of Southgate Tool Engineering Co. tells Los Angeles chapter techniques of making molds for plastics production. R. K. Halliday (right) of Wilson and George Meyer & Co. also participated in program, presenting plastics film.

In his introductory remarks, Mr. Halliday declared that a million and a half pounds of plastic materials are consumed monthly in the Los Angeles area.

The audience of 150 members and guests participated in a question period.

Education Committee Plans Program for Year Ahead

Members of the National Education Committee gather at Columbus, Ohio, June 3-4, to organize their activities for the coming year. From left: A. R. Diamond, Philadelphia chapter; Jay N. Edmondson, chairman, Columbus; H. E. Conrad, ASTE executive secretary; Prescott A. Smith, Boston; C. D. Wright, Niagara District; and Sherman B. Higbee, Rochester.

Iowans Have Stag Outing

Cedar Rapids, Iowa—Approximately 100 Cedar Rapids members enjoyed a twilight stag outing, June 15, at Mayvu Country Club.

After whetting their appetites in strenuous efforts at softball and horseshoes, the engineers sat down to a bountiful picnic dinner served by a local caterer.

Following this repast the then lethargic athletes amused themselves with bridge, chess, checkers and other table games. An hour of educational films filled an intermission in the games period.

Brown, Chief Engineer

Shreveport, La.—Walter Brown of Columbus chapter, ASTE, has been promoted to chief engineer of The Brewster Co., according to an announcement by H. S. Marioneaux, president and general manager.

Mr. Brown, who has served as assistant chief engineer for more than a year, will be in charge of design and mechanical engineering for the firm's oil field drilling equipment.

Inventor of a number of successful devices used in the petroleum industry, he has a Master's degree in M.E. from the University of Vienna.

GET ONE

ASTE BUILDING FUND PARTICIPATION CERTIFICATE

For details, see page 49 of this issue

New Set of Data Sheets Being Issued This Month

Detroit, Mich.—The National Standards Committee will make its seventh distribution of numerically indexed ASTE data sheets to the entire membership late this month, L. B. Bellamy, standards chairman, announces.

These sheets include data on arbors, drill and tap chucks, rest blades, drill presses, and drill, jig and liner bushings. They are supplied by Scully-Jones & Co., Acme Industrial Co. and Walker-Turner, Div. Kearney & Trecker.

In addition there will be two sets of Engineering Information data sheets, "Industrial Diamonds and Their Application" and "Cast Bronze Bearing Alloys," sponsored by the Industrial Diamond Association of America and the Bunting Brass & Bronze Co., respectively.

In preparation, according to Mr. Bellamy, are other Engineering Information data sheets on presses and press brake dies by Verson Allsteel Press Co. of Chicago, Ill. This material, Mr. Bellamy believes, is one of the best contributions of its kind to the ASTE data sheet manual.

Outing Ends Season

New Haven, Conn.—Favored with ideal weather, approximately 50 members and guests of New Haven chapter drove out to Guilford Lakes Club House at Guilford, June 11, for the annual chapter outing.

Golf, volley ball and quoits highlighted the sports program. After the games refreshments were served and prizes were awarded.

The event was the closing meeting of the season.

Other News In This Issue

Chapter	Page
Binghamton	54
Chicago	52, 54
Cincinnati	53, 56
Columbus	52
Denver	54, 55
Detroit	54
Erie	52
Evansville	52
Hartford	53, 55
Montreal	51
New Haven	55
Philadelphia	56
(Providence) Little Rhody	53
Rockford	55, 56
Toledo	56
Windsor	50
* * *	
Coming Meetings	56
Obituaries	56
Situation Wanted	56

Chapter listings include member as well as meeting news.

Directory of A.S.T.E. Chapter Chairmen

AKRON, NO. 47
Second Monday *
Theodore R. Mutto, *Chairman*
Republic Stamping & Enameling Co.
Bedford Ave., S.W.
Canton, Ohio

ATLANTA, NO. 61
Third Monday *
Charles M. Jenkins, *Chairman*
1229 University Dr., N.E.
Atlanta, Ga.

BALTIMORE, NO. 13
Wed. after 1st Mon. *
Andrew J. Jones, *Chairman*
3715 Ridgecroft Road
Baltimore 6, Md.

BINGHAMTON, NO. 35
Wed. after 1st Mon. *
Dean H. Erlenmeyer, *Chairman*
2107 Tracy St.
Endicott, N. Y.

BOSTON, NO. 33
Second Thursday *
Joseph P. Crosby, *Chairman*
38 Highland Ave.
Lexington 73, Mass.

BUFFALO-NIAGARA FRONTIER, NO. 10
Second Wednesday *
Erwin A. Slate, *Chairman*
1 Maplewood Dr.
Gasport, N. Y.

CEDAR RAPIDS, NO. 71
Third Wednesday *
John L. Stark, *Chairman*
Advance Service
111 2nd St., N.E.
Cedar Rapids, Iowa

CENTRAL PENNSYLVANIA, NO. 22
Third Thursday *
Charles F. Stephenson, *Chairman*
888 E. Market St.
York, Pa.

CHICAGO, NO. 5
Second Tuesday *
Anton J. Schwister, *Chairman*
2017 N. 77th Ct.
Elmwood Pk., Ill.

CINCINNATI, NO. 21
Second Tuesday *
Henry Bruewer, *Chairman*
6523 Iris Avenue
Cincinnati, Ohio

CLEVELAND, NO. 3
Second Friday *
Glenn A. Hier, *Chairman*
8024 Ackley Rd.
Parma 9, Ohio

COLUMBUS, NO. 36
Second Wednesday *
W. Kenneth Armagost, *Chairman*
2868 N. High St.
Columbus 2, Ohio

DAYTON, NO. 18
Second Monday *
Gordon Letsche, *Chairman*
146 Hadley Rd.
Dayton 9, Ohio

DECATUR, NO. 58
Last Tuesday *
Charles Hobbs, *Chairman*
1638 N. Maple Ave.
Decatur, Ill.

DENVER, NO. 77
First Wednesday *
James R. Matthew, *Chairman*
3423 E. 29th Ave.
Denver 5, Colo.

DETROIT, NO. 1
Second Thursday *
Monta O. Cox, *Chairman*
9562 Longacre Ave.
Detroit 27, Mich.

ELMIRA, NO. 24
First Monday *
Patrick G. Pecoraro, *Chairman*
351 Maple Ave.
Elmira, N. Y.

ERIE, NO. 62
First Tuesday *
Archie E. Weingard, *Chairman*
3012 Wayne St.
Erie, Pa.

EVANSVILLE, NO. 73
Second Monday *
Walter P. Schneider, *Chairman*
525 Lewis Ave.
Evansville 14, Ind.

FAIRFIELD CTY., NO. 6
First Wednesday *
Meredith W. Wilterdink, *Chairman*
RFD #1
Westport, Conn.

FOND DU LAC, NO. 45
Second Friday *
Allan L. McKay, *Chairman*
Rte. 1
W. DePere, Wis.

FORT WAYNE, NO. 56
Second Wednesday *
John F. Davis, *Chairman*
2946 Plaza Dr.
Ft. Wayne, Ind.

FOX RIVER VALLEY, NO. 72
First Tuesday *
Burt J. Phillips, *Chairman*
802 Augusta Ave.
Elgin, Ill.

GOLDEN GATE, NO. 28
Third Tuesday *
James V. Coulter, *Chairman*
Coulter Steel & Forge Co.
1498 67th St.
Emeryville, Calif.

HAMILTON, NO. 42
Second Friday *
George Gilmour, *Chairman*
1 Hillside Ave.
Dundas, Ont.

HARTFORD, NO. 7
First Monday *
Clayton S. Parsons, *Chairman*
J. K. Smit & Sons, Inc.
10 N. Main St.
W. Hartford 7, Conn.

HOUSTON, NO. 29
Second Tuesday *
Paul E. Brainard, *Chairman*
255 Fauna
Houston 12, Texas

INDIANAPOLIS, NO. 37
First Thursday *
Howard W. Curfman, *Chairman*
317 N. Holmes Ave.
Indianapolis 22, Ind.

KANSAS CITY, NO. 57
First Wednesday *
Samuel M. Waas, *Chairman*
4119 Highland
Kansas City 4, Mo.

LITTLE RHODY, NO. 53
Third Wednesday *
Delbert C. M. Krahnke, *Chairman*
20 Shortway Rd.
Cranston 10, R. I.

LOS ANGELES, NO. 27
Second Thursday *
R. Gerald Stronks, *Chairman*
4225 Irving Pl.
Culver City, Calif.

LOUISVILLE, NO. 54
Second Wednesday *
Norwood H. Booker, *Chairman*
3125 Eagle Pass
Louisville 13, Ky.

MADISON, NO. 75
Tues. after 1st Mon. *
Vern McFair, *Chairman*
3506 Lake Mendota Dr.
Madison, Wis.

MID-HUDSON, NO. 74
Second Tuesday *
Joseph L. Petz, *Chairman*
11 Meadow Rd.
Poughkeepsie, N. Y.

MILWAUKEE, NO. 4
Second Thursday *
Arthur C. Gudert, *Chairman*
R. #7, Box 150
Wauwatosa 13, Wis.

MOHAWK VALLEY, NO. 78
Last Tuesday *
Ernest J. Masucci, *Chairman*
141 Genesee St.
New Hartford, N. Y.

MONTREAL, NO. 50
Second Thursday *
Marc A. Cote, *Chairman*
460 Merton Ave.
St. Lambert, Que.

MUNCIE, NO. 70
Second Wednesday *
Charles L. Marker, *Chairman*
1301 S. Beacon St.
Muncie, Ind.

NASHVILLE, NO. 43
Third Friday *
Sidney W. Stowell, *Chairman*
Box 45
Donelson, Tenn.

NEW HAVEN, NO. 41
Second Thursday *
Gerard P. Schoeller, *Chairman*
Marlin Firearms Co.
85 Willow St.
New Haven 11, Conn.

NEW ORLEANS, NO. 60
Second Wednesday*
Carl N. Hazlewood, *Chairman*
6574 General Haig St.
New Orleans 19, La.

NEW YORK, GREATER, NO. 31
First Monday *
Julius Schoen, *Chairman*
1015 Grand Concourse
New York 52, N. Y.

NIAGARA DISTRICT, NO. 65
First Thursday *
Norman B. Coleman, *Chairman*
13 South Dr.
St. Catharines, Ont.

NORTH TEXAS, NO. 51
Second Friday *
Ephrem L. Minch, *Chairman*
613 Edgefield Rd.
Ft. Worth 7, Texas

NORTHERN NEW JERSEY, NO. 14
Second Tuesday *
John E. Epprecht, *Chairman*
RFD 1, Parsippany Blvd.
Boonton, N. J.

PEORIA, NO. 31
First Tuesday *
Harold E. Schmidt, *Chairman*
1016 Miller St.
Washington, Ill.

PHILADELPHIA, NO. 15
Third Thursday *
Emil Kitzman, *Chairman*
3128 Princeton Ave.
Philadelphia 24, Pa.

PITTSBURGH, NO. 8
First Friday *
Frank T. Boyd, *Chairman*
1615 Broad St.
Greensburg, Pa.

PONTIAC, NO. 69
Third Thursday *
Cash Bond, *Chairman*
2 Delaware
Pontiac 18, Mich.

PORTLAND (MAINE), NO. 46
Fourth Friday *
Eldon L. Wishart, *Chairman*
63 Glenwood Ave.
Portland 5, Me.

PORTLAND (OREGON), No. 63
Third Thursday*
Lewis R. Ellingwood, *Chairman*
7714 S.E. 17th Ave.
Portland 2, Ore.

POTOMAC, NO. 48
Thurs. after 1st Mon. *
Harry Springer, *Chairman*
220 E. Windsor Ave.
Alexandria, Va.

RACINE, NO. 2
First Monday *
G. W. Christiansen, *Chairman*
2512 Mitchell St.
Racine, Wis.

RICHMOND, NO. 66
Second Tuesday *
Paul C. Hermansdorfer, *Chairman*
42 S. 12th St.
Richmond, Ind.

ROCHESTER, NO. 16
First Monday *
William R. Gordon, *Chairman*
125 Monteroy Rd.
Rochester 10, N. Y.

ROCKFORD, NO. 12
First Thursday *
Karl B. Kaiser, *Chairman*
1928 N. Rockton Ave.
Rockford, Ill.

SAGINAW VALLEY, NO. 68
Third Thursday *
Harold A. DeVore, *Chairman*
2215 Begole St.
Flint 4, Mich.

ST. LOUIS, NO. 17
First Thursday *
William G. Callies, Jr., *Chairman*
Modern Screw Prod. Co.
2307 N. 9th St.
St. Louis 6, Mo.

SAN DIEGO, NO. 44
Second Tuesday *
Glave S. Bunch, Jr., *Chairman*
7884 Broadway
Lemon Grove, Calif.

SCHENECTADY, NO. 20
Second Thursday *
Fred L. Kinum, *Chairman*
General Electric Co.
Bldg. 28—305
Schenectady 5, N. Y.

SEATTLE, NO. 39
Second Tuesday *
Harold R. Pinkerton, *Chairman*
651 W. 51st St.
Seattle 7, Wash.

SOUTH BEND, NO. 30
Second Tuesday *
Paul Beeler, *Chairman*
R. R. #1
Bristol, Ind.

SPRINGFIELD (ILLINOIS), NO. 64
First Tuesday *
William P. Fromuller, *Chairman*
2420 S. 13th St.
Springfield, Ill.

SPRINGFIELD (MASS.), NO. 32
Second Monday *
Daniel B. Wesson, *Chairman*
55 Stockbridge St.
Springfield, Mass.

SPRINGFIELD (OHIO), NO. 76
Fourth Thursday *
Roy H. Mumma, *Chairman*
738 Patrick Rd.
Springfield 52, Ohio

SYRACUSE, NO. 19
Second Tuesday *
Fay Adkinson, *Chairman*
108 Hillsboro Pkwy.
Syracuse 3, N. Y.

TOLEDO, NO. 9
2nd and 4th Wednesday *
Rolland H. Mogle, *Chairman*
3722 Leybourne Ave.
Toledo 12, Ohio

TORONTO, NO. 26
First Wednesday *
Frederick J. Crook, *Chairman*
104 Thompson Ave.
Toronto 18, Ont.

TRI-CITIES, NO. 23
First Wednesday *
Donald A. Wangelin, *Chairman*
2042 43rd St.
Rock Island, Ill.

TWIN CITIES, NO. 11
First Wednesday *
Raymond L. Martin, *Chairman*
4248 10th Ave. S.
Minneapolis 7, Minn.

TWIN STATES, NO. 40
Second Wednesday *
Lee M. Davis, *Chairman*
61 Elm St.
Springfield, Vt.

WESTERN MICHIGAN, NO. 38
Second Monday *
John T. Maghielse, *Chairman*
1430 Garfield N.W.
Grand Rapids 4, Mich.

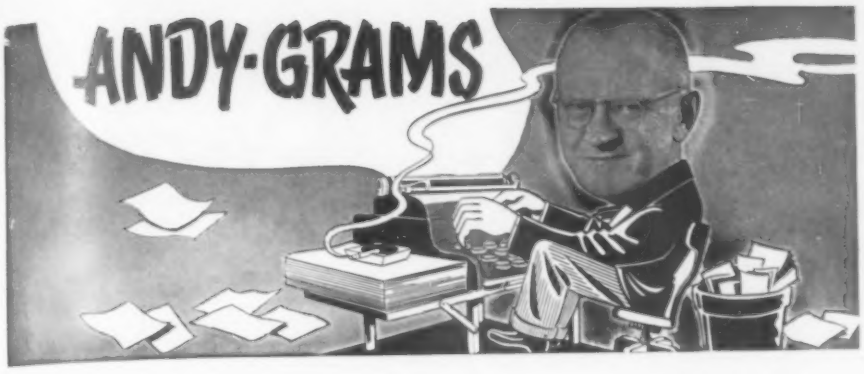
WICHITA, NO. 52
Second Wednesday *
William F. Grabendike, *Chairman*
406 N. Bluff
Wichita, Kansas

WILLIAMSPORT, NO. 49
Second Monday *
Edwin H. Sears, *Chairman*
1356 Mansel Ave.
Williamsport, Pa.

WINDSOR, NO. 55
Second Monday *
William A. Thomas, *Chairman*
Ford Motor Co. of Canada, Ltd.
Tool Design Dept., Plant 2
Windsor, Ont.

WORCESTER, NO. 25
First Tuesday *
Carl D. Schofield, *Chairman*
1 Reynolds St.
Worcester 6, Mass.

* CHAPTER MEETING NIGHT



Got right interested in the review of a current novel—*Nineteen Eighty-Four,* by George Orwell—in which, by 1984, the world has been divided into three big superstates of which the U.S.A.—renamed Oceana—is one. The English language is now called Newspeak, a jargon condensed from what is currently termed basic English. Vocabulary is reduced to a minimum of words, thus all but eliminating the main tool for transfer of thought.

All classics of the past have been translated into the new language, to call it that, thereby reducing literature to the senseless status of surrealistic painting which, in my estimation at least, constitutes the ultimate nadir in artistic illiteracy. And so, control of a world society centers in bureaucratic minorities which, themselves illiterate by present-day standards, would shape the destinies of majorities by now reduced to a state of moroncy.

Oh sure, it's all pseudo-prophecy and probably won't happen; nevertheless, the novel has created something of a sensation and has probably evoked more editorial comment than any literary work of the day, the Kinsey Report not excepted. Yet, as Mark Twain remarked about a tall tale, it might happen, and I'm not so sure that it isn't being insinuated on a trial scale, especially in the technical publications field. For there are individuals who would so standardize the phraseology of technical writing that the whole would be reduced to a repetitive and therefore deadly monotony.

Oddly enough, I have found that while superficially articulate and giving an impression of erudition, these individuals are nevertheless ignorant of many of the commonly used English terms. So, being personally incapable of writing at the level of the educated, at whom they sneer, they would have their contemporaries "writing down" to the level of the uneducated, thereby denying everybody a vocabular ladder with which to scale to the higher literary levels.

While frankly preferring the simple, explicit terms where these serve the purpose, I nevertheless cannot subscribe to such retrogression in language. The idioms and vernacular in my personal column to the contrary, I feel that engineers and professional people in general demand the best in both spoken and written language. Certainly there is no reason to standardize their thinking which, in the long run, would stilt both oral and written expression.

As the saying goes, any damphool can shoot down a well although, fortunately for world progress, leaders in contemporary thought still prefer to aim at the stars. Even the caveman did that, with the result that language has evolved from a few gutturals and monosyllables to a vocabulary so rich in its nuances that verbal portrayal can now be as delicately shaded as the most exquisite painting. Until a better medium presents itself, language stands as the universal tool for transfer of thought.

Well, there are leaders in all walks of life, some leading their followers to the depths, others to the heights. Apropos which I have before me an excerpt from the farewell address of the late Dr. L. H. Beck, president of Upsala College during my attendance there and one of the finest men I have ever been privileged to know. I quote it, in gist, for its inspiration:

"Lowest of all men are they who only live to satisfy their senses; higher they who rejoice in deeds of simple kindness and loathe . . . envy and calumny; highest . . . they who live in the faith of eternal thoughts and . . . pour out their lives as a sacrifice if so they may inspire others with the same . . . faith." Words to live by, eh?

As a break in the tedium of repetitive chores, I had a visit from Adrian Potter, past ASTE executive secretary who, now several years back in Springfield, Mass., has definitely projected the Eastern States Exposition into a new high—that is, if a gross net in excess of 100 grand can be taken as an indication. But then, there never was any valid question regarding Ade's capability.

We got talking about the state of the union and, between us, decided that this so-called recession is largely fictitious. Automobile manufacture is far behind demand, and there is an unprecedented spurt in industrial building and expansion that, together with evident optimism among several of the larger corporations, augurs well for the near future. So keep your chins up; the best is yet to come.

Roiling the picture is the stock market, at time of writing wavering 'twixt hope and despair. As a result, a lot of people are panicked into selling sound values that are as quickly bought up by wise buyers at about 50c on the dollar. Speaking for myself, I have faith in the soundness of America's industries.

Responding to invitation, drove out to ASTEer Oscar Theander's "project" out Novi way, said visit confirming my faith in the versatility of tool engineers. Oscar has completed the first unit of a country estate and—with the help of his better half—did all of the work himself. This included framing the house, roofing, cement work, brick veneering—and an A-1 job that was!—wiring and plumbing. He'd even made his own window sash, all that along with clearing the land and raising a garden. Nice job, Oscar—and wife.

Had a call from HQ asking if I could locate a March '38 The Tool Engineer which some member had requested. I found it after sweltering a couple of hours up in the attic where, by now, an accumulation of magazines threatens to disrupt the serenity of family life. You know how women are, always wanting to do housecleaning just when everything is peaceful and quiet.

Anyway, friend wife turned to the Andygrams (then Handy Andy's Workshop) and remarked that it was written just after a trip to Florida—a little over eleven years ago, by the way. So I read the Column myself, and was reminded that the Old Man at Midland Steel Products—Einar Almdale, if you want his name—had shooed us off on an early vacation a/c the slump that occurred in '38.

Reading along, I saw where I'd kidded Providence and Dayton for not joining the ASTE—both did, not long after that—and where I expressed confidence in the state of the union. Among other things, I wrote about the (then) coming ASTE Tool Show—our first, by the way. The concluding paragraph read: "Well boys, that's all until the bell rings, except to tell you that the Show is in the bag. So come, . . . and join your fellow tool engineers in pushing this recession into the limbo of forgotten things." And certainly our first Tool Show helped to turn the tide.

At that, it was quite an undertaking, with the credit for its success largely due to the dynamic Ford R. Lamb, then executive secretary. As my share, I contributed my usual optimism and enthusiasm, which got me in Dutch with some of my more conservative fellow Directors. Nothing new in my life; I've been in Dutch and out of it ever since joining the Society. Usually, things worked out.

Well, we're in another recession of sorts—some call it getting back to normal, whatever that is—and with another ASTE Tool Show in the offing; that is, next April or so in Philadelphia. And if the present state of getting back to normal isn't over by then, we should at least initiate a business boom which, according to the guys who are supposed to know, is due to start about next spring. Good timing, eh?

Andy

THE TOOL ENGINEER'S *Service Bureau*

FREE BOOKLETS AND CATALOGS CURRENTLY OFFERED BY MANUFACTURERS

Cylinders, Low Pressure

Brochure describes construction features and capacities of standard sizes with information on mounting brackets, cylinder cushions, etc., as well as dimensional drawings and cylinder selection data. Catalog 236, *Hanna Engineering Works*, 1765 Elston Ave., Chicago 22.

Die Heads, Insert Chaser

Style DM insert die head for Brown and Sharpe Automatic screw machines described in Bulletin No. 14A: elaborates on construction and advantages and lists tables of dimensions, capacities and carrier ranges. *Eastern Machine Screw Corp.*, Truman & Barclay Sts., New Haven 6, Conn.

Forging

Reference data booklet, "Metal Quality", for use of design engineers, metallurgists and production and management executives; describes development of metal quality throughout hot working operations; discusses selection of metals for forgings, procedures for various kinds of parts etc. *Drop Forging Association*, 605 Hanna Bldg., Cleveland 15.

Gages

Catalog No. 49 describes line of tungsten carbide and norbide reversible plain and threaded plug gages and centerless lapping machines. Features of root relief on major ring thread diameters and truncated set plugs. *Size Control Co.*, 2500 W. Washington Blvd., Chicago.

Gages, Block

Illustrated folder describes gage (height, snap and divider) blocks for quick assembly and claimed accuracy to thousandths of inch. *Webber Gage Co.*, 12900 Triskett Rd., Cleveland 11, Ohio.

Gages, Fixed

Illustrated, 116-page catalog of factual and practical information plus price and specification lists, diagrams and tables, for use of buyers and users of perishable gages. Conforms to new unified screw thread system recently agreed upon by English-speaking countries. *Sheffield Corp.*, Dayton 1, Ohio.

Gages, Thread

Folder describes and pictures advantages of reversible type of thread gage. *Swedish Gage Co. of America*, 8900 Alpine Ave., Detroit 4, Mich.

Hose, Flexible

Enumerates and illustrates typical application to show adaptability of products; also includes installation data and price and specification lists. Bulletin No. 30, *American Ventilating Hose Co.*, 15 Park Row, New York 7.

Hydraulic Oils

Series of processed hydraulic oils especially developed for use in hydraulically operated industrial equipment described in folder which also gives viscosity range and service properties. Publication Dept., *Swan Finch Oil Corp.*, RCA Bldg., West, New York 20, N. Y.

Hydro-Check

Folder HC-600 tells the story of Bellows' Hydro-Check, adjustable hydraulic resistance unit for air-powered equipment and conventional air cylinders; includes illustrations and dimensional diagrams. *The Bellows Co.*, 222 W. Market St., Akron 9, Ohio.

Metal, Powdered

"Powdered Metal In Your Production Picture" presents primary advantages, design possibilities, plus table of average physical properties of Powdermet parts. *Powdered Metal Products Corp. of America*, 9335 W. Belmont Ave., Franklin Park, Ill.

Metal, Sample Index

An index, designed for permanent filing, contains samples of pre-plated metals, Nickeloid metals finished in chrome, copper, nickle and brass available on zinc, steel, copper, brass and aluminum basses. Also includes samples in bright and satin finishes, striped and crimp designs and gives data on sizes of sheets, coils and flat strips available. *American Nickeloid Co.*, Peru, Ill.

Microscope, Measuring

Illustrated bulletin of profile measuring microscope for high precision measuring and control of profiles, by Henri Hauser, Ltd. Available from *Hauser Machine Tool Corp.*, Manhasset, N. Y.

Motors, A-C

Bulletin C-130 enumerates and illustrates design features of explosion-proof, corrosion-resisting a-c motor; plus description of impregnating and baking techniques used to protect Reliance motor stators. *Reliance Electric & Engineering Co.*, Sales Promotion Dept., 1076 Ivanhoe Rd., Cleveland.

Reamers, Solid Carbide

Bulletin A-62 describes line of solid carbide reamers and solid carbide bodies with steel shank; illustrates use with series of case histories showing solution to various job problems; price lists included. *The Atrax Co.*, Francis Ave. and Day St., Newington 11, Conn.

Regulator, Rotating

Bulletin K-2001 describes and illustrates by photo and schematic diagrams, a-c motor driven rotating regulator for voltage and current (tension) regulation. *Reliance Electric & Engineering Co.*, Cleveland, O.

Standards, Hydraulic

Reprint of "Hydraulic Standards for Industrial Equipment" set by Joint Industrial Conference includes data sheets on diagrams, controls, equipment, accessories plus glossary of terms used. Cut-away illustration presents comparison between Miller cylinders and standards. *Miller Motor Co.*, 4027 N. Kedzie Ave., Chicago 18.

Tapping, Hand

Four-page folder pictures and describes heavy duty universal hand tapping machine and lists economical advantages, driving method and specifications. *Producto Machine Co.*, 990 Housatonic Ave., Bridgeport 1, Conn.

Tools, Carbide Tipped

Line of standard carbide tipped tools for turning, boring, facing and threading pictured and described in condensed table form according to seven types of stocked tools. Gives order number, price, dimensions, nose radius and tip grade. *Super Tool Co.*, 21650 Hoover Rd., Detroit 13.

Transmission, Industrial

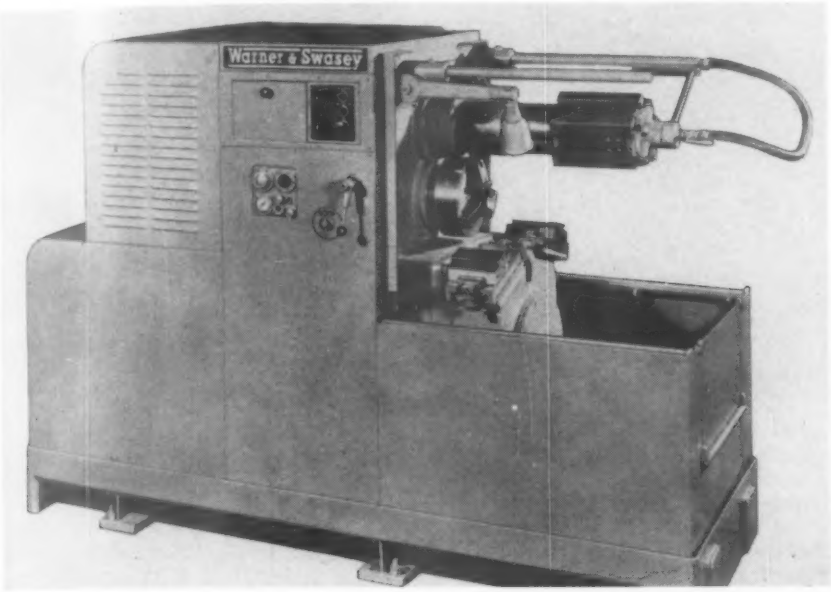
Two-page catalog supplement describes 2-speed automatic transmission for providing broad range of speeds and special ratios not obtainable electrically, plus dimensional drawing and data. *Western Manufacturing Co.*, 3400 Scotten Ave., Detroit 10.

Welding Alloy

First quarter, consumer's issue, Ampco Welding News, discusses use of Ampco-Trode, Phos-Trode, Beryl-Trode to overcome industrial problems involving wear or heavy pressures. *Ampco Metal, Inc.*, Dept. WN-1, Milwaukee 4, Wis.

TOOLS OF TODAY

Single Spindle Automatics by Warner & Swasey

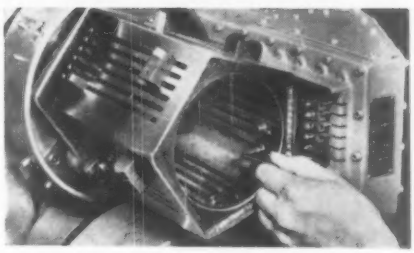


The 1-AC single-spindle automatic Chucking Machines, recently put into service by the Warner & Swasey Co., 5701 Carnegie Ave., Cleveland 3, Ohio, are designed for high efficiency operation in diversified production. The machines feature front and rear cross slides and a five-faced overhead turret, handling work up to 8½ in. in diameter and up to 6 in. in turned length.

Trip-blocks are set in slots on a pentagonal drum at the rear of the turret shaft to control feeds, spindle speeds, length of cutting stroke and skip indexing. Either or both cross slides can be selected to operate with any or all turret faces, and a quick Allen wrench adjustment controls late and dwell cross slide operation. Cam changes are thus done away with, set-up is speedy and simple, and tooling stations and controls are easily accessible. Chips drop directly into a large pan below the spindle and may be removed while the machine is in operation.

Set-up controls include feed and speed selectors, automatic and hand operation switches, and "Forward", "Reverse" and "Index" push buttons. Operating controls include spindle and coolant control switches, and "Cycle Start", "Motor Start" and "Stop" push buttons.

Spindle speed range is from 56 to 1948 rpm, and eight speeds are available from any given change gear set-up, as a result of four automatic changes and a high-low shift lever. Eighteen feeds are available, from 0.002 to 0.083 in., and three are automaticlly



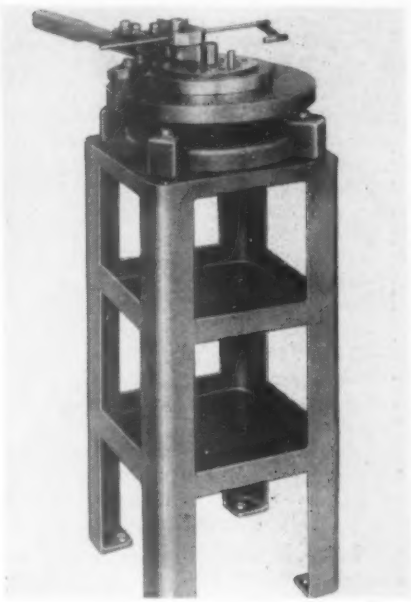
available during operation for each gear setup. The machine cannot be started without the gear box covers in place. **T-8-1**

Improved Utility Shapers

The Cincinnati Utility Shaper, manufactured by The Cincinnati Shaper Co., Cincinnati 25, Ohio, is again in production but in improved form. Answering the need of many shops for a fast utility tool for a moderate price, this shaper is said to embody the many refinements found in the larger Cincinnati models. The table, supported directly on the cross rail without an apron, is said to be heavy enough to take full load without table support. This construction adds to the rigidity of the table by reducing the overhang.

The improved models are equipped with higher speeds for practical and profitable application of carbide tools. Cutting speeds over 250 fpm are said to be possible on a 10 in. stroke. Extra features available include an improved tool lifter, power down feed to the head and power rapid traverse to the rail. The Utility models are made in 16 and 20 in. stroke sizes and can be equipped with a 3 or 5 hp motor drive. Bulletin T-6 gives complete specifications. **T-8-2**

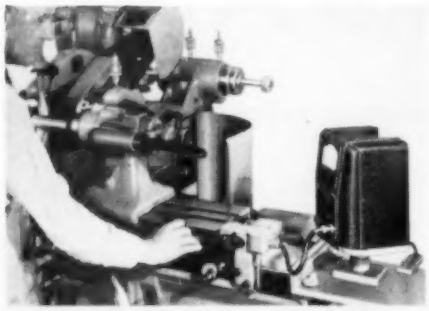
Cabinet for Di-Acro Benders

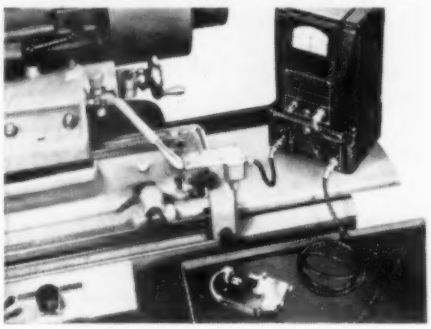


O'Neil-Irwin Manufacturing Company, 375 Eighth Ave., Lake City, Mich., announces a Floor Cabinet designed for mounting of Di-Acro Benders.

While these Benders have been produced and are now in wide use for both production and experimental operations, they have previously been offered as bench-mounted tools. Therefore, users should be interested in the availability of a mounting pedestal that not only enables the Benders to be advantageously located but also provides shelf space for accessory tools, such as bending mandrels. **T-8-3**

Electronic Setting of Grinder Swivel Tables





Among late developments by Brown & Sharpe Mfg. Co., Providence 1, R. I., is the "Electralign" for electronic setting of grinding machine swivel tables. The device obviates the slow cut-and-try setting for straight shaft and exact taper grinding and reduces setting to a fast, simple and exact operation.

The Electralign ignores the conditions of the table pivot and table wear which may occur with time, the weight of the workpiece and location of the head and footstock on the table. True alignment and swivel movements are accurately indicated without relation to these variables.

The Electralign locates a strain gage measuring head at each end of the sliding table and measures the movement of the swivel table. Thus, high sensitivity is obtained, with displacement of 0.0001 in. readily detected and amplified to graduations on an indicating scale. As the amplifier scale is set for the work length, deflections are directly read without interpolation or transposition.

The upper photo, at left, shows an operator making a single and positive correction by moving the table zero adjusting mechanism until the Electralign pointer reads zero. Lower photo, left, shows a special comparator applied to the Electralign and Electralign-Comparator Selector, the latter supplementary when it is desired to make external or internal measurements employing a comparator in conjunction with setting table for alignment.

Also, by Brown & Sharpe, are the Nos. 2L and 2LB Surface Grinding Machines. The former, shown at right, has full automatic feed, while the latter model has hand feed only. Both machines are offered with drive from moping molded products from the press.

These machines are adapted to dusty or severe operating conditions and have the capacity and convenient operating features of the companion Brown & Sharpe Nos. 2 and 2B surface grinders. The machines incorporate full automatic lubrication for all moving parts and surfaces, and the table sliding surfaces are completely guarded from abrasive dust.

T-8-4

Oil Pilot Valves

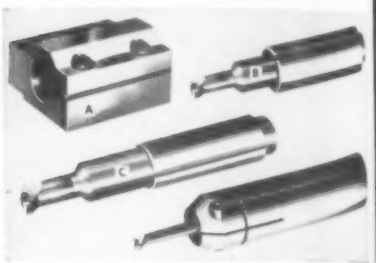
A line of Oil Pilot Valves, known as the Series 7000 and now offered by Gerotor May Corp., Baltimore 3, Md., are designed for remote control of oil pressure operated 4-way hydraulic valves.

Operational control is gained by a fork lever design which, when actuated by a moving part of the device being powered, permits the remote reversing of the main 4-way valve. Both fork lever-and-fork and hand lever types are supplied. The latter—illustrated—permits manual interruption of the cylinder's forward or return stroke at any time.

Four standard mountings are available: pipe line, base, foot, and panel. Gerotor oil pilot valves may be had with all ports blocked in neutral, all ports open to exhaust in neutral, and cylinder ports open to exhaust and pressure port blocked in neutral. Twenty-five models, including solenoid operation, are described in Gerotor May Catalog Section 201. **T-8-5**

Holder for Single-Point Tools

A Holder—upper left—especially designed for use of Bokum single point boring tools on lathes has been announced by Bokum Tool Co., 14773 Wildemere, Detroit, Mich. With the aid of recently developed shanks and adaptors, turret lathe operators may now have at their disposal Bokum boring tools in a theoretical range of diameters from 1/16 in. to approximately 4 inch.



The Holder—BT-24—has a 1½ in. bore to accommodate the shanks and adaptors which are used to hold the smaller tools. Split bushings—B—with 1½ in. O.D. and 1 in. and 1¼ in. inside diameters, are provided for use of Bokum tools Nos. 4 to 12 to give a boring range of minimum diameters from 11/16 to 2 in.

An Adaptor—C—of 1½ in. outside diameter accommodates tools No. 00000 to 3 which have a ⅜ in. shank, and theoretically will give a minimum diameter range from 1/16 to 9/16 in. Shanks of three different diameters with threaded ends are provided for the attaching of the separate cutter heads, Nos. 4 to 12.

The shanks are made of heat treated chrome nickel alloy of high tensile strength, with centers provided at each end to permit turning the neck to any desired size for any practical length required, and to give maximum rigidity.

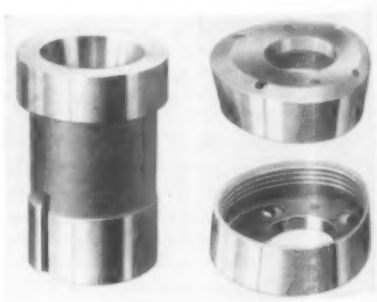
T-8-6

Replacement Chuck Parts

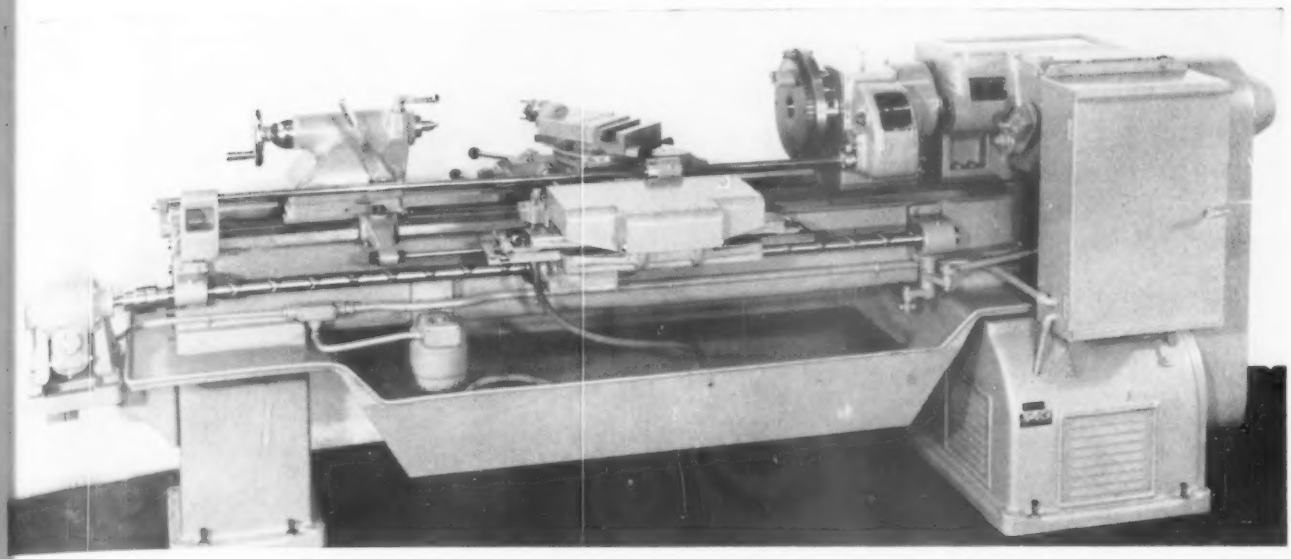
Chuck Sleeves and Nuts for replacement in Brown & Sharpe machines are now offered by Ballas Collet Manufacturing Co., 1557 E. 27th St., Cleveland 14, Ohio, as an adjunct to its line of collets, feed fingers and pads.

Designed to correct difficulties of run-out, these parts are fabricated from chrome nickel alloy steel and precision ground, with concentricity guaranteed by the maker. The parts, which are said to have the same specifications as the original components, are available from stock in sizes 00 to 22.

T-8-7



Universal Relieving Attachments



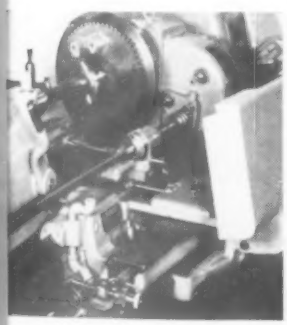
Shown, pictorially, is a recent development in Universal Relieving Attachments recently brought out by The Sidney Machine Tool Company, Sidney, Ohio. This attachment incorporates a 4 to 1 spindle speed reducer, integral with the change gear box, which eliminates the need for 2-speed motors or other devices necessary to reduce spindle speeds. The attachment can be applied to Sidney lathes already in the field as well as to new machines.

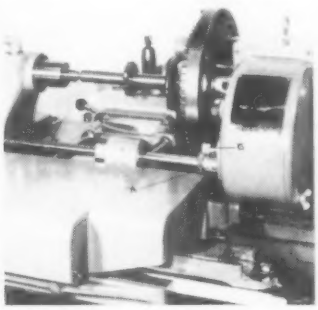
Shown in the large photo is a rear view of a Sidney lathe with the relieving attachment installed. From left to right, smaller photos, is a rear view with taper attachment guard in the raised position to show the right-angle drive from the change gear housing to the compound. Universal points have been eliminated entirely, and the complete driving mechanism is mounted on the back side of the lathe to allow free access to all lathe controls.

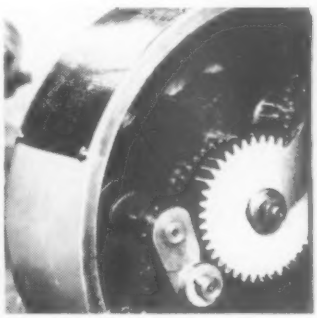
Next in order is a rear view showing the change gear housing with index plate conveniently located and in full view of the operator. A timer—A—enables the operator to pick up any relief, at any point, with minimum effort. Clutch lever—B—disengages the relieving attachment drive for conventional turning.

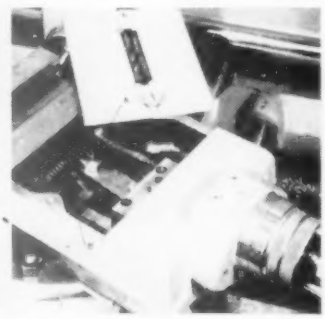
Next photo shows the change gear housing with cover in the open positions. Change gears are readily accessible by swinging the quadrant in front of the opening. Photo at right shows how adjustable cam throw is provided by loosening stud—A—and sliding the arm to required location in shoe B. Cam throw is readily adjusted and replacement of cams with various throws is not necessary.

The attachment can be used to relieve form, straight and bevelled milling cutters, straight and taper reamers, and for internal, external and end relieving as well as relieving of spiral fluted cutters. **T-8-8**









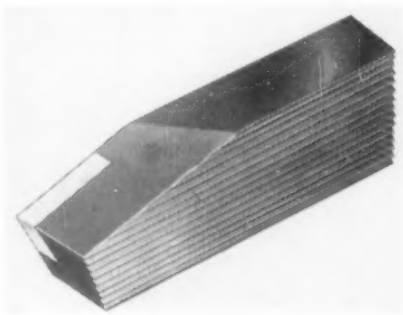
Micrometer Adjusting Nut

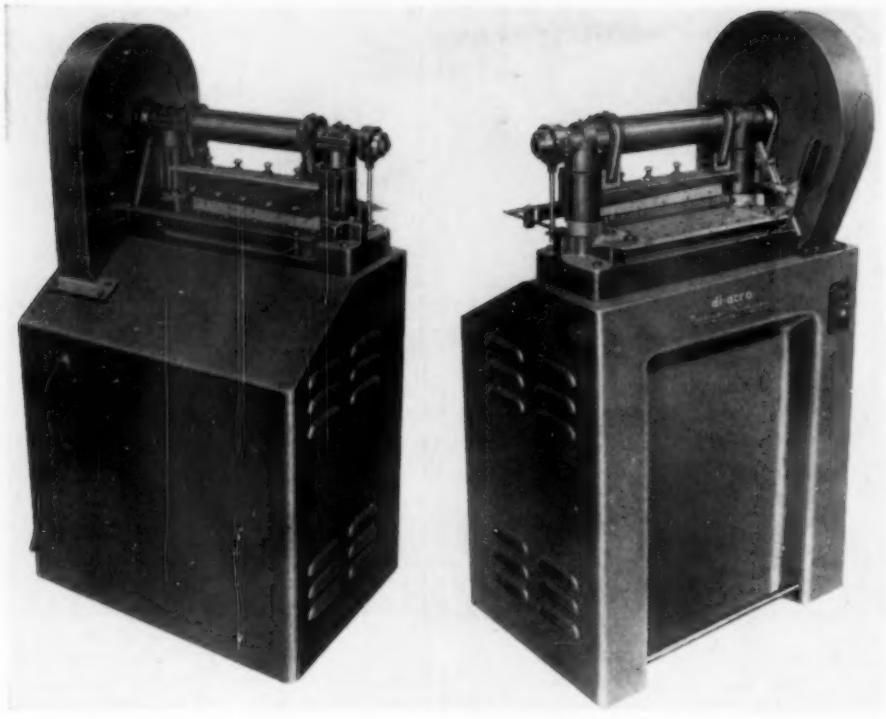
The Gairing Tool Co., 21223 Hoover Road, Detroit 32, Mich., announces the Ful-Grip Micro-Nut, an adjusting nut designed for individual tool adjustment on multiple spindle setups. The nut, which may be used on threaded adapters and holder assemblies with or without keyways, has accurate adjustment guided by 0.001 in. graduations.

A feature of the nut is that the set screw does not bear against the adapter threads; rather, it provides a full grip on the threads all around by moving top and bottom parts of nut in opposite direction, thus providing firm and parallel contact against end of machine spindle. Fully described in an illustrated bulletin, available on request. **T-8-9**

Serrated Cutter Blades

Kennametal Inc., Latrobe, Pa., is manufacturing serrated milling cutter blades with brazed-on Kennametal tips. Produced to specifications in a wide variety of forms, these blades can be furnished ground with any of the common types of serrations such as 90 deg, 60 deg, or those having combination plane and serrated surfaces. Further particulars are available from the manufacturer. **T-8-10**





Di-Acro Now Powered

O'Neil-Irwin Manufacturing Company, which has previously confined their line of Di-Acro equipment to hand powered machines, now announces the Di-Acro Power Shear, the first of a line of power driven equipment by this company.

Offered in 12 and 24 in. sizes, with capacities to 16 ga. sheet steel, this unit is precision built for precision shearing of the smaller parts in a wide variety of materials from thin tissues to maximum capacity.

The primary value of the power-driven tool lies in its production possibilities, since even a woman operator may now maintain a high output without the fatigue that inevitably results from any hand-operated machine used over extended periods of time.

This tool is to be fully described in a 40-page Di-Acro Catalog, available on request by writing the O'Neil-Irwin Manufacturing Company at 375 Eighth Ave., Lake City, Minn. **T-8-11**

Milling Attachments

Marvin Machine Products Inc., Canton, Ohio, announces a line of attachments designed to give greater versatility to bench milling machines. The line includes a Vertical Mill Attachment, a Slotting Attachment, and a low-cost Rotary Table.

The vertical mill attachment—Model V-1200—is driven from the bench mill spindle and allows use of the automatic feeds of the machine. Designed for a wide variety of work, it can be set at angles and pulled out past the travel of the table for large work.

The slotting attachment—Model S-1070—also requires no extra motor. Attached to the bench mill spindle, this slotter makes possible the production of dies, squared or splined holes, internal gears and many other shapes which cannot ordinarily be made on the bench mill. Like the vertical mill attachment, it can be set at angles or pulled out past the travel of the table. Stroke is adjustable from 0 to 2 in., and the holder takes tools having ½ in. shank.

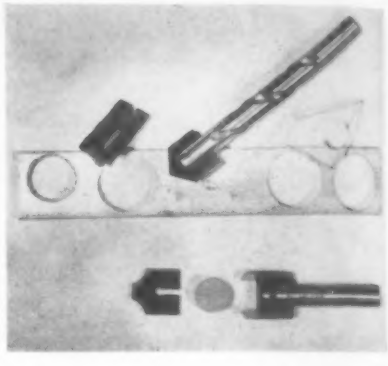
The rotary table—Model R-1102—is rigid and proportioned for bench mill or shaper. The 6 in. table is graduated in degrees and locks from the bottom to assure against tilting. All castings are iron, and the worm is hardened and ground, with 40:1 ratio. Three 3 in. index plates and hand wheel are furnished. Height is $2\frac{5}{8}$ in.

For further information, literature and prices write or phone H. B. Hazerodt, Director of Sales, 414 Ford Bldg., Detroit 26. **T-8-12**

High-Speed Insert Tools

W. W. Williams Industries, RFD No. 2, Athol, Mass., announces the "Zit" line of high-speed steel Insert Tools, designed particularly for production drilling in plywood, plastics, and soft metals. For drilling of ferrous metals, they are intended only for short-run, emergency or experimental work.

Design is based on the flat drill principle to preclude hogging into the work, even when drilling into holes almost to size of the drill used. Inserts are keyed to a tongue which is an integral part of the shank, a construction said to absorb all torque and side thrust within the shank. Because of the small amount of steel required for the blanks, cost is said to be unusually low. Heat treated blanks are available for grinding to special shapes.



Shown at bottom in the photo are special cutters, the one at lower right used for cutting out sterling silver discs. At upper left is a 4-flute reamer or counterbore blank; and at center a 1-1/16 in. insert in standard 5 in. long shank. Shanks range from 3 to 24 in. long, the latter intended for deep hole drilling. As an indication of their ruggedness, the 1-1/16 in. tool shown is said to have cut off several dozen nails and spikes before drilling the holes in the magnesium strip on which it is superimposed. The tools are all fully described in a comprehensive bulletin, available on request. **T-8-13**

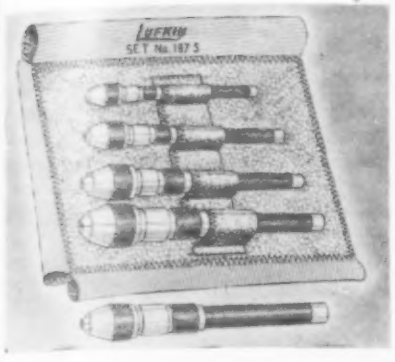
Improved Auger Bit

Introduced by Chicago-Latrobe, 411 W. Ontario St., Chicago 10, Ill., is the Type 700 Auger-Bit, designed to permit faster penetration with less effort. Also, it permits of considerably easier sharpening than is possible with conventional twist-type bits. It can be sharpened by grinding. Available individually or in sets from $\frac{3}{8}$ to 1 in. in increments of $\frac{1}{8}$ in. **T-8-14**

Turn to Page 78 for Handy Tools of Today Coupon

Chuck-end Pin Vises

Chuck-end Pin Vises, individually or in a set of four, are announced by the Lufkin Rule Company, Saginaw, Mich. Capacities are 0-0.055 in.; 0.025-0.075 in.; 0.045-0.135 in.; and 0.110-0.200 in.



Well proportioned and designed for holding small stock to be worked or for holding taps, drills, scribers and small files, these vises have hardened jaws and holes running entirely through the handles. A straight, smooth bearing portion, close to the chucks, insures more true running when clamping in collets or chucks. **T-8-15**

Improved End Mills

A line of End Mills, developed by the Wendt-Sonis Company, Hannibal, Mo., incorporates improvements in standard carbide end mills to provide extra strength in the body of the tool and additional backing for support of the cutting edges.

Cutting edges are diamond lapped; in addition, shanks are specially heat treated for greater strength and rigidity. A special feature of the Wendt-Sonis end mill used for non-ferrous materials is greater chip capacity.

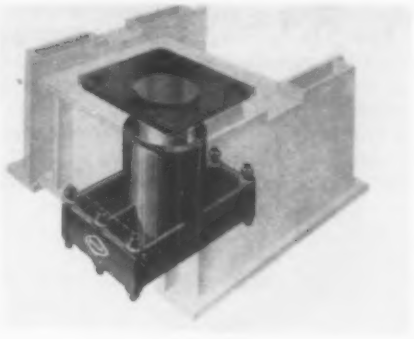
The tools are available in straight and taper shank styles, with straight and right or left hand spiral flutes, and in styles for machining all types of steel, non-ferrous materials and cast iron. Sizes range from ¼ in. to 2 in. **T-8-16**

Low Melting Alloy

A low melting alloy—the Eutec-Cast Iron Filler—by Eutectic Welding Alloys Corp., 40 Worth St., New York 13, N.Y., has been developed to fill cracked castings, cylinder blocks and other metallic parts, aluminum excepted, right "on the spot" without dismantling.

Claimed is the ability to bond on old, rusty metal at bonding temperature of only 500 deg F. Sold as a unit containing a roll of the Filler and a jar of Eutector Flux, both in the one package. **T-8-17**

Die Cushions by Baker



As announced by A. L. Baker, President, Baker Brothers, Inc., 1000 Post St., Toledo, Ohio, now offers pneumatic and hydro-pneumatic Die Cushions for all types of power presses. These cushions are an addition to the Baker line of machinery.

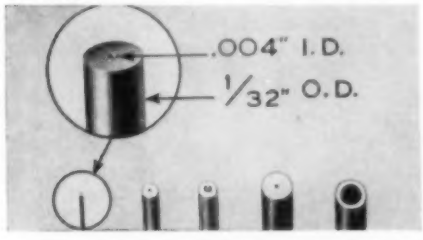
The pneumatic cushions are offered in standard sizes from 4 in. through 30 in. diameter in double piston type. The size and number of cushions in a given installation depends on the individual press bed construction and pressure requirements.

The Baker hydro-pneumatic cushions are self-contained and are said to be applicable to any press regardless of size or make. **T-8-18**

THE HARD
WAY
GETS YOU MORE
Right—gets you more production—more for your money. For long wear and close tolerances specify OHIO WAYS. Uniformly hardened to Rockwell 64 to 66 C scale.
The OHIO KNIFE Co.
CINCINNATI 23, OHIO, U. S. A.

Extruded Carbide Shapes

Cemented carbide tubes, ranging in size from 1/32 in. O.D., with an I.D. of 0.004 in., to 9/16 in. O.D. with a wall thickness of 1/16 in., are now being manufactured by extrusion methods in the plant of Kennametal Inc. of Latrobe, Pa. Even still smaller or larger tubes, and those having a greater range in relative dimensions, are said to be also commercially possible.



The O.D. is rough extruded 0.010 to 0.015 in. oversize, and the I.D. is held to ± 1 percent of specified size and accurately concentric. The ratio of I.D. to O.D. may cover a wide range—that is, either a relatively thin or thick wall. The tubes can be supplied in either of two classes of Kennametal. One, a straight tungsten carbide, has the high hardness common to this material, combined with unusual strength, and is suitable for parts subjected to abrasion at normal temperatures.

The other is essentially titanium carbide, having a hardness comparable to tungsten carbide, but of considerably lesser weight. Its chief distinguishing property is that it withstands corrosion and abrasion at elevated temperatures that rapidly disintegrate cast alloys; for example its resistance to thermal shock is said to be higher than that of ceramics. Its transverse rupture strength at 1800 deg F is stated as 100,000 psi.

T-8-19

WE **HOPE** YOU ARE
COST CONSCIOUS
if so
you will try Milne's **3** great savers

1. HOLLOW DIE STEELS
(Tubular Tool Steel)
AIR, OIL, WATER HARDENING GRADES
SAVE TOOL COSTS as against RING FORGINGS
BORING FROM SOLID BARS
NO SCALE - NO DECARB
SAVE TOOL COSTS
(Our Cost Study tells why!)

2. GRAPHITIC TOOL STEELS
MACHINE MORE EASILY - HARDEN MORE EASILY and GALL LESS EASILY
(Our Catalogue tells why!)

3. STRESSPROOF(R) COLD FINISHED STEEL
HIGH IN-THE-BAR PHYSICALS
REPLACES MANY COSTLY ALLOY STEELS
EASY TO MACHINE
WORK HARDENING GIVES LONG LIFE
(Our Booklet tells why!)

A. MILNE & CO.
(ESTABLISHED 1887)

WAREHOUSES
New York - Pittsburgh - Chicago
Boston - Philadelphia - Cleveland
New Britain

SALES OFFICES
St. Louis - Dayton - Rochester, New York - Bridgeport - Springfield, Mass.

PACIFIC COAST HEADQUARTERS
San Francisco, California

For Southern California
Tayler & Spotswood of California
Los Angeles, California

For Pacific Northwest
Pacific Machinery & Tool Steel Co.
Portland, Oregon

Steel Hardening Compound

Wilson Carbide Company, 60 East 42nd St., New York 17, N. Y., announced Hi-Speed-It, a steel hardening compound said to harden carbon steel drills, as an example, where they can be used to drill automobile spring leaves and tough alloy metals. Shown in the photograph is an ordinary nail, hardened with the compound and cutting nicks in a chrome-manganese rail.

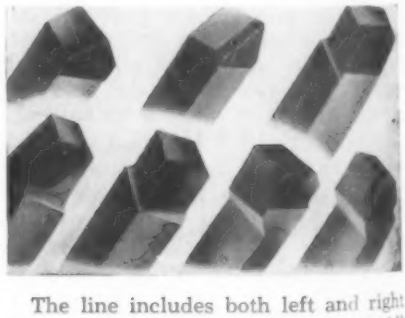
Essentially an activated steel catalyst, the compound contains no cyanide, yet, method of hardening closely follows cyanide case hardening in that the tool or part is brought to proper heat, dipped or rolled in the compound and then quenched in cold water or brine.

The compound can be used to increase hardness of carbon and high-speed steel tools, or to harden cold rolled or machine steels.

T-8-20

Standard Tool Line by Super

Super Tool Company, 21650 Hoover Road, Detroit 13, Mich., now offers from stock a complete line of seven types of carbide tipped tools for turning, boring, facing, and threading in a wide range of sizes.



The line includes both left and right hand styles in side cutting types. All tools are standard with optional grades of carbide for cutting steel or other materials, with other grades obtainable on request. The tools have been priced with present downward trends in mind, and can be altered by the user for special operations at nominal cost.

T-8-21

Automatic Thread Roller

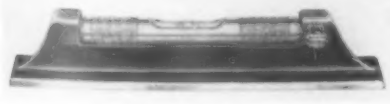
The Hartford Special Machinery Co., Hartford 5, Conn., announces a high production Thread Roller for machine screw sizes from No. 2 to No. 10 which is said to produce from 120 to 150 pieces per minute. Thread length capacity is $\frac{1}{8}$ to $1\frac{1}{2}$ in. The machine is designed to roll threads on common and socket head cap screws, gimlet-point and self-tapping screws, screwnails, and drive screws, as well as handling of unlimited special applications.

Model 190-H, as it is called, rolls Class 3 thread fits consistently, limited only by the accuracy of the blanks used. Die pockets are precision fitted to eliminate the necessity for shimming and squaring while the dies are standard sizes of the flat type, adjustable while the machine is running to control the thread fit accuracy. Changeover is said to be rapid and simple.

Features include automatic hopper feed with notched clearing wheel, filtered lubrication system carrying to all important parts and supplying clean cutting oil to dies, greatly prolonging their life. **T-8-22**

12-Inch Precision Level

A sensitive 12-inch Precision Level designed especially for leveling machine tools is announced by the South Bend Lathe Works, 417 E. Madison St., South Bend 22, Ind. The level has a ground and graduated vial mounted in a 12-in. cast iron frame with the base precision ground on all useful surfaces, including the V-way for leveling shafts.



The spirit vial, carefully selected to provide the correct sensitivity for quick, accurate leveling, is substantially mounted in the frame and protected from accidental breakage by an aluminum alloy cylinder which may be revolved to completely enclose the vial.

A catalog with specifications of this popularly priced 12-inch level is available on request. **T-8-23**

Non-Magnetic Collet Chucks

Announced by Erickson Tools Division, 2311-A Hamilton Ave., Cleveland 14, Ohio, is the non-magnetic Standard Face Plate Collet Chuck, used for inspecting electrical parts.

Every part of the collet chuck, except the knurled spanner lock nut, is of a non-magnetic conductor material. Current must flow through collet chuck freely for exacting inspection of electrical part. Concentricity must also be held during inspection. The collet chuck is said to meet all the requirements.

The chuck incorporates the Erickson double-angle principle to assure concentricity through firm, positive contact over entire OD surface. It also allows fast, easy loading and unloading of parts for inspection. **T-8-24**

Dependable Available

ABC DRILL JIG BUSHINGS

HEADLESS PRESS FIT • SLIP RENEWABLE
FIXED RENEWABLE • HEAD PRESS FIT
Also HEADLESS LINERS, LOCATING JIGS, LOCKSCREWS, CLAMPS

A·S·A STANDARD

UNEXCELLED FOR ACCURACY AND CONCENTRICITY

REPRESENTATIVES:

BOSTON, MASS.
M. A. Siebert Co.
GArrison 7-0104

BUFFALO, N. Y.
W. S. Gallagher Co.
Garfield 5500

CLEVELAND, OHIO*
Die Supply Company
UT 1-0550

DALLAS, TEXAS
The Stanco Co.
Riverside 5138

DAVENPORT, IOWA
Davenport Engineering Corp.
Davenport 2-1791

DAYTON, OHIO*
Geo. D. Laughter Co.
Kenmore 4191

DENVER, COLO.
Iver J. Esbenson Co.
Main 3831

DETROIT, MICH.
Diemaker Supplies Co.
Trinity 1-2865

HOUSTON, TEXAS
Chickering Tool & Equip't. Co.
W. 6-8584

INDIANAPOLIS, IND.*
The Standard Die Supply, Inc.
Riley 6319

NEW YORK, N. Y.
Carl Eberhard
WIsconsin 7-9193

MILWAUKEE, WIS.
The Stone Company, Inc.
Broadway 2452

MINNEAPOLIS, MINN.
Chas. W. Stone Co.
Geneva 8631

PHILADELPHIA, PA.
Albert R. Dorn
DElaware 6-3553

RHINEBECK, N. Y.
Frank A. Hart
Rhinebeck 437

ROCHESTER, N. Y.
Fink Tool Co.
Munroe 5679

SOUTH BEND, IND.
Formrite Tool Co.
South Bend 2-3396

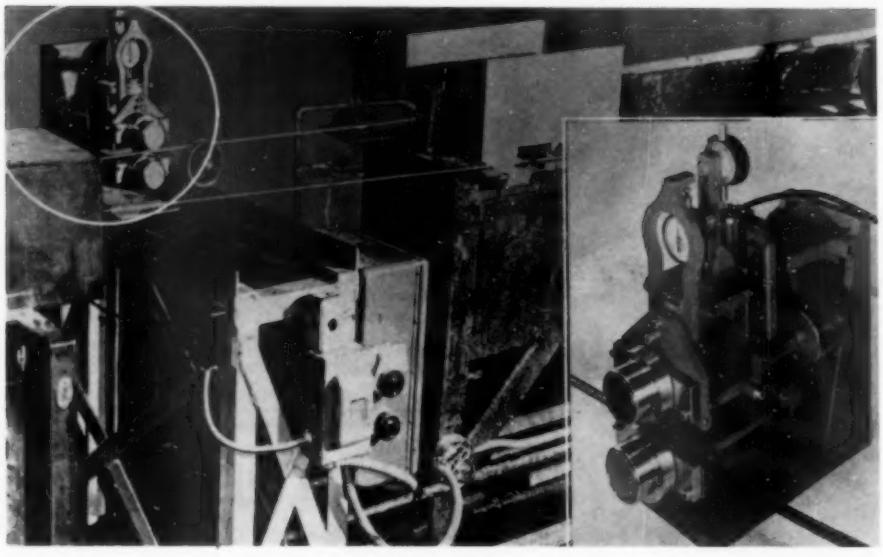
STRATFORD, CONN.*
Ellsworth Steel & Supply Co.
BRidgeport 7-3317

*Stock of popular sizes maintained at these locations. Complete factory stock and warehouse at Garwood, N. J.

WRITE FOR CATALOG, PRICE LIST AND OTHER INFORMATION NEEDED BY THE TOOL ENGINEER

ACCURATE BUSHING COMPANY
437 North Ave., GARWOOD, N. J. • Westfield 2-2415
ABC TRADE MARK

Gage to Automatically Control Coating Thickness



Model 493 B-59 Continuous Measuring Gage, by Federal Products Corp., 1144 Eddy St., Providence, R. I., is designed to automatically and accurately control the thickness of plastic coating deposited on copper electrical wire.

Should coating thickness vary out-of-tolerance, a Federal Electricator transmits electrical impulses, thereby automatically controlling the machine so that a uniform coating thickness is maintained. If desired, a continuous thickness recorder can be installed so that supervision can have a continuous record of down-time and machine fluctuations.

The gage is said to be inexpensive and easy to install. Other types are available for glass tubing, metal rods, strip material and other continously produced material. In the case of coatings, as described above, accurate gaging of thickness saves the cost of material that might be wasted by too thick a coating. **T-8-25**

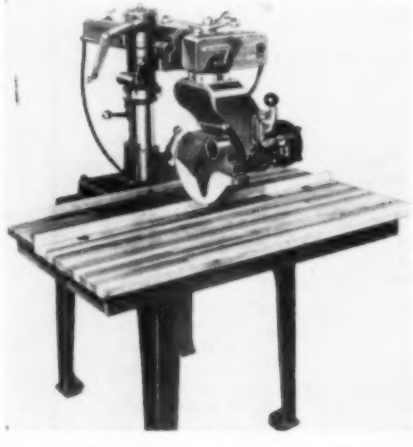
Versatile Shear

An improved type of cam and lever-actuated Shear said to cut off flat strip stock with punch and die precision is announced by The DoAll Co., 254 N. Laurel Ave., Des Plaines, Ill.

The shear is primarily designed for cutting off bandsaw blades square and flat in preparation for welding into a band, and will take blades up to 0.045 in. thick and 1¼ in. wide.

As contrasted to shearing the blades with snips, which leaves the edges deformed and out-of-square, making welding bumpy and further weakened by grinding, the blade shear eliminates these troubles because it produces a true and smoother cut. It has the added advantage of "staying put" since it can be mounted on the saw or permanently wall or bench-mounted in convenient location. **T-8-28**

Radial Saw



The "900" Series Radial Saw, in production by the Walker-Turner Division, Kearney & Trecker Corp., Plainfield, N. J., includes features said to make cutting easier and faster on all wood, plastic, and similar materials. These are: a Centr-Pivot offset yoke that permits all cuts to be made in the convenient table area; 3⅛ in. capacity with 9 in. blade; a geared motor with 2½ times overload capacity—extra cool running; 24 in. crosscut travel; rips to center of 48 in. panel; full work-visibility; rigid, clean-cut accuracy—holding design incorporates taper latch indexing and locks that are easy to reach and operate; and a big table of laminated hard maple, 46 in. x 24 in. **T-8-26**

Arc Welder for Light Work

A small low-cost Arc Welder, operating off a 110 volt light circuit, yet having design and operating characteristics comparable to larger industrial welders, is announced by The Lincoln Electric Company, Cleveland 1, Ohio.

With a maximum output of 60 amperes, the "Lincwelder 60"—as it is called—can be used for a variety of light gauge metal working jobs, as well as for joining heavier material such as strap, pipe, tubing, angle and other shapes.

The unit is available through Lincoln dealers and is sold complete with 6-foot insulated cord and standard plug for conventional 110 volt light socket, protective welding head shield and lens, electrode holder and 9-foot cable, ground cable, a supply of electrode and brazing rod. **T-8-27**

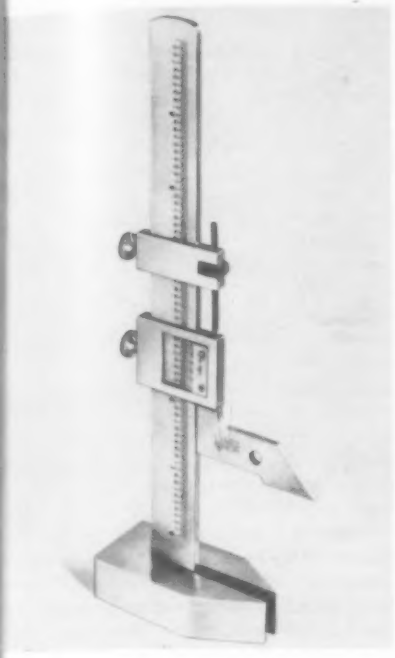
Mechanically-Held Tool Bits

Kennametal Inc., Latrobe, Pa., announces a line of offset tools, having mechanically-held Kennametal tips, for machining operations such as facing with tool shank perpendicular to the work, or turning with the tool shank parallel to the work axis.

The tip of these tools—Styles FRH and FLH—is held in position in a heat-treated steel shank by means of a spring steel clamp. When the tip becomes dull from use it can be advanced and reground many times until a major part of the Kennametal is used. Grinding is usually required on one surface only. Because no steel is ground from the shank it serves as a permanent tool holder.

These tools are stocked in 5 sizes: 1 in. square x 7 in. long; 1¼ in. square x 7 in. long; 1½ in. square x 10 in. long; 1 in. wide x 1¼ in. high x 9 in. long; 1 in. wide x 1½ in. high x 10 in. long. **T-8-29**

Ver-atile Height Gage



A compact Vernier height gage, designed to speed the work of tool makers, inspectors and bench workers, is announced by Vard, Inc., 2981 E. Colorado St., Pasadena 8, Calif.

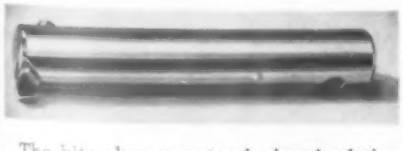
The gage has a slotted base which makes possible direct readings from 0 to 6 inches, eliminating the necessity for computations and the consequent possibility of errors. Because the Vernier scale is adjustable, the zero setting can be maintained at all times.

For faster operation when used for direct layout on parts, the gage incorporates a scriber point as an integral part of the jaw; also, a hole in this jaw permits quick attachment of indicators for all types of inspection.

T-8-30

"Taper-Bit" Boring Tools

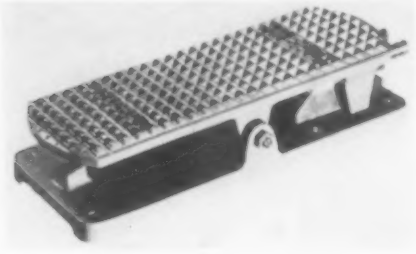
A line of "Taper Bit" Boring Bars, by Rockford Precision Tool Co., 924 King St., Rockford, Ill., is designed along interesting lines. No screws or clamps are required to hold the bits in place; rather they are ground to taper and fit into a lapped taper hole in the bar. The bearing surface thus provided is said to preclude turning under heavy cuts and to provide a rigidity closely approximating that of a solid tool.



The bits always extend ahead of the bar; hence, grooving or boring may be done to shoulder or faces. Bars may be used either right or left hand, and the bits may be ground as desired. As another feature, when the bits are shortened as a result of repeated sharpening, they may be used up by inserting in a smaller taper seat at the opposite end of the bar. **T-8-31**

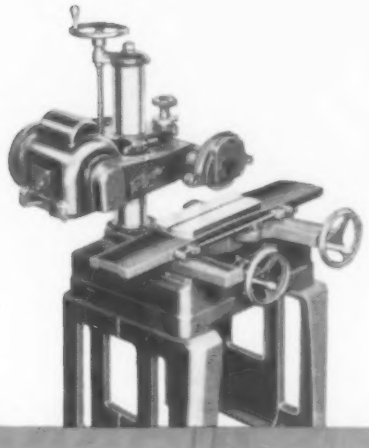
Quick-Acting Foot Valve

Mead Specialties Co., 4114 No. Knox Ave., Chicago 41, Ill., announces the fast acting Model 201 Foot Valve for use with air-operated manufacturing equipment.



Construction features include a low treadle surface, for easy foot operation; treadle pivot on centers, wherein hardened 60 deg cone-pointed screws permit infinite adjustment for wear; and self-cleaning, poppet type construction, with seals of synthetic rubber.

The valve can be used for 3-way operation as follows: Normally closed, self-locking, press toe to open, press heel to close; normally open, press heel to close, toe to open; normally closed, self-releasing, when valve stays open only when held by the operator; and normally open, self-releasing, when valve stays closed only when held by the operator. **T-8-32**



DELTA MILWAUKEE®

Delta Toolmaker Surface Grinder**

Has wide graduations on micrometer, for close settings. Unique wheel adapter saves time and redressing. Many other features. 7" x ½" wheel, 1¼" bore. With simple attachments, this machine becomes an efficient tool-and-cutter grinder or a chipbreaker grinder.

No. 24-105 **$375*** without wheel, motor, or switch

These DELTA® machines cut grinding costs for toolroom and production work

Delta Grinder with Twin-Lite Safety Shields**—Twin-Lite Safety Shields act as "built-in goggles," flooding your work with light. Fully-machined tool rests. Balanced wheels. Lubricated-for-life ball bearings. No. 23-405 — Complete with safety shields, lamp bulbs, wheel guards, and wheels. - - $114*

Delta Carbide Tool Grinder—Combined with Delta's standard tool grinder for hogging down the shank steel, this machine gives you a perfect working combination for sharpening tungsten carbide tools. No. 23-555—Complete with lamp attachment, water pot, and wheels - $154*

Delta grinders are available in both bench and floor models — with current and speeds to suit any requirement. Simple, easily-adjusted attachments increase the utility of these machines.

Your nearby Delta distributor has these popular grinders on display now. Inspect them there. Ask about buying on easy credit terms. Look for the name of your Delta distributor under "Tools" in the classified section of your telephone directory — call him today.

POWER TOOL DIVISION
Rockwell MANUFACTURING COMPANY
MILWAUKEE 1, WISCONSIN

Tear out coupon and mail today

POWER TOOL DIVISION
Rockwell Manufacturing Co.
610H E. Vienna Ave., Milwaukee 1, Wis.
Send me a free copy of Delta Catalog A-48.

Name.....
Title.....
Company.....
Address.....
City.....(.....) State.....

M-36A

*Prices subject to change without notice.

**Trade Mark Reg. U. S. Pat. Off.

Production Surface Grinders

Mattison Machine Works, Rockford, Ill., has purchased the line of production grinding machines formerly made by the Hanchett Manufacturing Company of Big Rapids, Mich. Among these machines are the Plano-type with vertical spindle, shown in the upper photo, the No. 36 rotary type Surface Grinder with vertical spindle, and the No. 72 rotary-type Automatic, also with vertical spindle.

Shown in the lower photo is the Mattison High-Powered Precision Surface Grinder, made with table sizes 12 to 36 inches wide x 36 through 192 inches in length. These machines, which incorporate hydraulic feed, are ruggedly built to hog off stock in rough grinding, yet capable of maintaining close limits of accuracy and providing fine finish under continuous high production.

Together with the addition of the former Hanchett line, Mattison Machine works is now equipped to furnish surface grinders of practically any type needed for production purposes.

T-8-33

DETROIT OFFICE SPACE FOR RENT

Unusually attractive office space available in our new building. Ideal for manufacturer's agent or district office. Air conditioned. Write or phone American Society of Tool Engineers, 10700 Puritan Ave., Detroit 21, Michigan. Phone: UNiversity 4-7300.

MARK IT FOR MARKET

WITH GTS MARKING TOOLS

MODEL 175 HYDRAULIC MARKING MACHINE

FOR ROLLING lettering into flats, rounds, or irregular shapes.

FOR KNURLING fine line or diamond design on round pieces.

DEEP MARKING FOR PERMANENCE

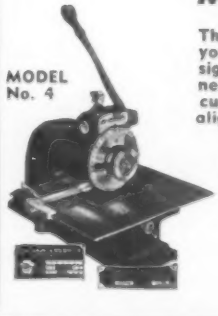
HIGH PRODUCTION

Simply send prints of parts showing desired marking and its location, plus hourly production requirements for free recommendations.

GEO. T. SCHMIDT, INC.
1804 W. BELLE PLAINE AVE., CHICAGO 13, ILLINOIS

CLEAR

NAMEPLATE MARKING

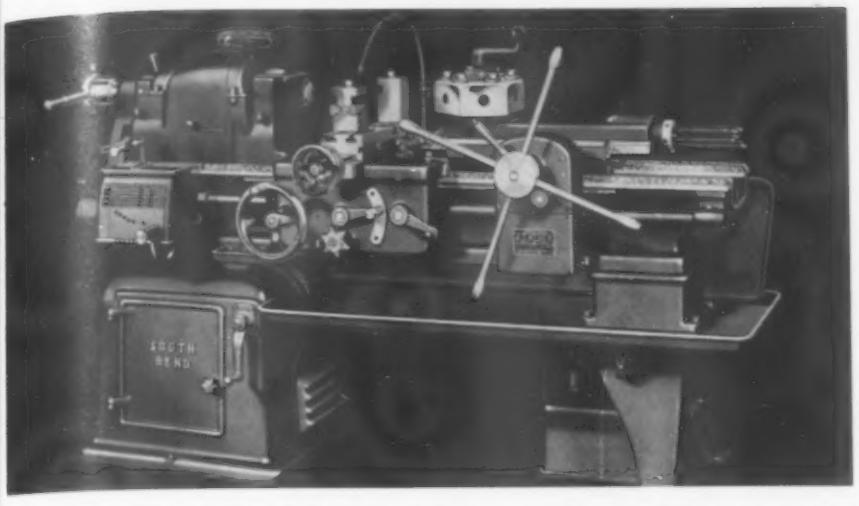


The nameplate on your product is your signature; keeps it neat and legible! Accurate location and alignment are assured with this NAMEPLATE DETAIL PRESS.

- Simple Operation
- Perfect Alignment
- Uniform Depth

GEO. T. SCHMIDT, INC.
1804 W. BELLE PLAINE AVE.
CHICAGO - 13 - ILLINOIS

Precision Turret Lathe By South Bend



The South Bend Lathe Works has resumed production of their No. 2-H Precision Turret Lathe, discontinued during the war due to concentration on toolroom and engine lathes. Improvements and refinements in design, contributing to greater efficiency and accuracy of the post-war models, include a turret locking mechanism said to index the turret head within plus or minus 0.0005 in., measured 4 in. from the turret face.

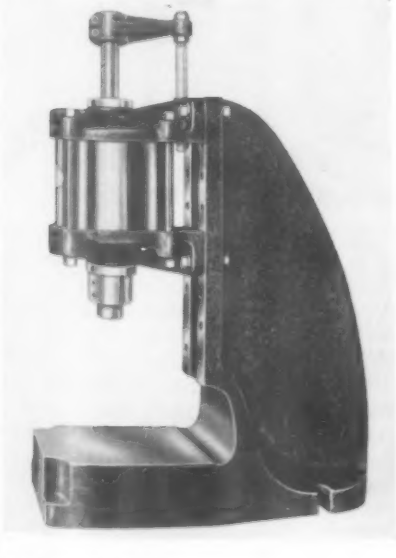
Designed for the efficient production of duplicate parts, the 2-H Turret Lathe can be equipped with universal or independent chuck for machining castings, forgings, and irregular-shaped parts, or, it can be equipped with hand-lever draw-in collet attachment for machining bar stock or tubing. Maximum swing over the bed is 16¼ in., over cross slide 6⅞ in. Maximum collet capacity is 1 in. round, and hole through spindle is 1⅜ in. The hexagon turret has 1½ in. diameter holes for turret tools. Clearance from center of tool hole to top of turret slide is 2½ in. The effective feed of the turret slide is 6⅛ in.

The universal carriage has friction clutch drive for 48 power cross-feeds ranging from 0.0006 to 0.0312 in., and 48 power longitudinal feeds ranging from 0.0015 to 0.0841 in.; also lead screw and split nut for cutting 48 pitches of screw threads ranging from 4 to 224 per inch. All changes for threads and feeds are made through the quick change gear box at the headstock end.

The lathe is designed to take full advantage of the higher cutting speeds of tungsten-carbide tools. Twelve spindle speeds range from 16 to 880 rpm, and a two-speed motor permits quick change from high to low speeds for reaming and tapping operations. Complete description and specifications of the No. 2-H Turret Lathe are contained in Catalog No. 67-F, available on request from the South Bend Lathe Works, 417 E. Madison St., South Bend 22, Ind. **T-8-34**

Improved Arbor Press

The Air-Powered Arbor Press, manufactured by the Bellows Company, 222 W. Market St., Akron, Ohio, has been further improved by the use of a specially designed double-acting air cylinder to provide full control of both the advance and retract strokes of the ram.



While the power thrust developed is said to be approximately 20 times the air line pressure applied, fully controlled air pressure enables the press to be used for assembly operations involving the most fragile parts. The press operates on any air line pressure up to a maximum of 175 lbs.

Positive adjustment of stroke length, from a fraction of an inch to a maximum of 2½ in., is effected by means of double-end piston equipped with an adjustable locking collar. The ram is non-rotating, enabling the tool to be used for light die cutting or stamping operations where register is involved. Ram clearance is adjustable to four positions in units of 1½ in. with a maximum ram clearance of 7 in. Throat clearance is 5 in. Table size 8 x 9 in., and four mounting holes facilitate bench mounting. **T-8-35**

with D. A. STUART CUTTING FLUIDS

THERE are several reasons why it pays to give more than ordinary attention to selection of cutting fluids. Experience has shown that such attention can, more often than not, achieve these results:

1. **Longer Tool Life.**
2. **Better Finish.**
3. **Greater Output per Machine.**
4. **Less Scrap Loss.**
5. **Reduction in Number of Different Oils and Blends Required.**

●

These benefits add up to Lower Operating Costs.

D. A. Stuart Oil Co. is prepared to help you *stretch your machining dollar* by the soundly engineered application of superior cutting fluids. Ask to have your nearby D. A. Stuart Oil Co. representative call to *prove* this statement. Send for D. A. Stuart literature.

"WISE ECONOMY RESULTS FROM WISE SELECTION OF CUTTING FLUIDS"

STUART *service goes with every barrel*

D.A. Stuart Oil CO.

2727-49 South Troy Street, Chicago 23, Illinois

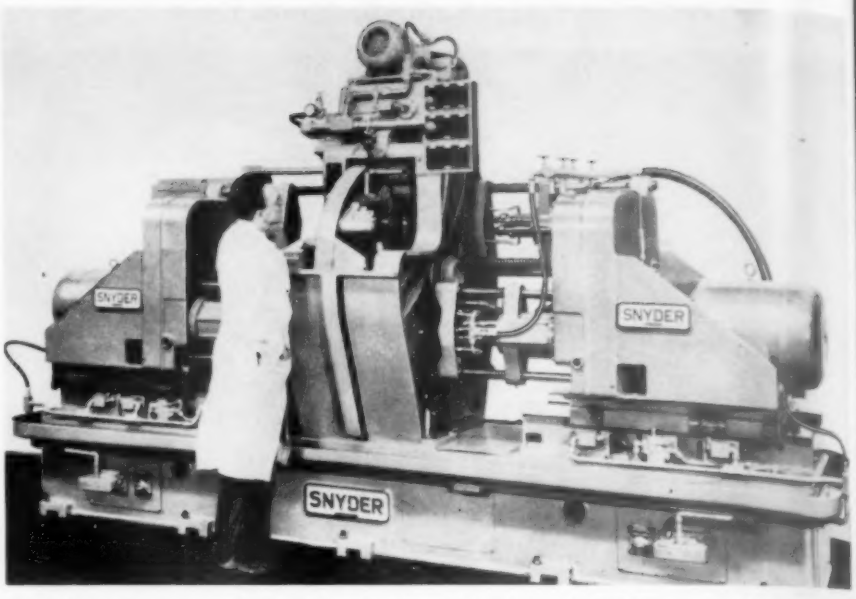
Automatic Cycle Machine

An automatic Cycle Machine for drilling, counter-sinking, rough boring and semi-finish reaming automotive transmission parts is announced by Snyder Tool & Engineering Co., 3400 E. Lafayette, Detroit, Mich. The work piece is located and clamped in special, air-operated, diaphragm chucks, and a hydraulically operated pressure plate is provided at the drilling station to support the part and chuck against drill pressure.

The machine is equipped with a Snyder, 4-station, Geneva operated trunnion, on the right side of which is an 18-spindle multiple drill head with one master head carrying three 6-spindle pot heads, each with its own bushing plate.

On the left side of the trunnion is a 6-spindle head, also with a master head but with a single 6-spindle pot head. Two dummy heads carry spring-loading bushing plates to pilot the line boring and reaming tools.

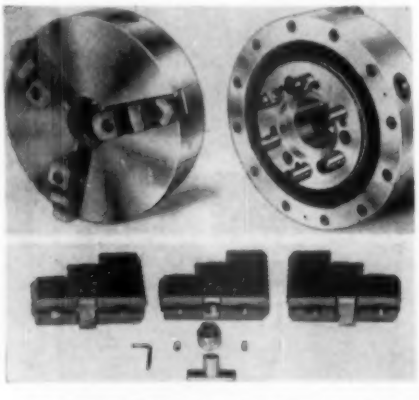
After loading and unloading at Station 1, the machine automatically indexes to Sta. 2 where the left and right heads each drill and countersink



six holes. At Sta. 3, the left head advances the busing plate to the pilot line boring bar and the right hand head rough bores six holes. At Sta. 4, the left head advances the bushing plate to the pilot line reamer and the right hand head semi-finish reams the six holes. Work cycle is automatic and the machine is designed for operation by unskilled help. Production rate is stated as 75 cycles an hour at 80 percent efficiency. **T-8-36**

Improve Chucks

Designed for higher speed operation of machine tools, a "Whitaloy" Chuck, by the Whiton Machine Company, New London, Conn., features a body forged of a special analyses, heat treated alumium alloy. The light weight facilitates quick starting and stopping, with reduced strain on braking mechanism. Precision built throughout, the chuck is said to be adaptable to all spin die noses and is available in all sizes and types up to 25 in.



Also by Whiton, is the "Tru-Loc" top jaw adjustment—lower illustration—designed to compensate for wear in universal chucks. Its purpose is to get more use out of jaws and scroll without the need of purchasing new ones.

The "Tru-Loc" operates on the principle of an eccentric bushing with adjusting screws. This allows adjustment of the top jaw up to 1/32 in., and further provides for trueing up the jaws to compensate for wear in threads of both scroll and jaw. **T-8-37**

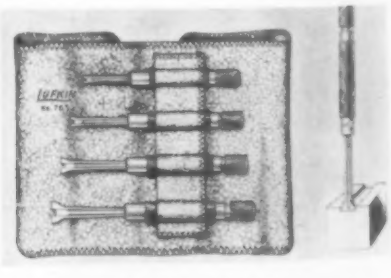
8-Inch Shaper by Logan

Logan Engineering Co., 4901 W. Lawrence Ave., Chicago 30, Ill., announces an 8 in. Shaper of advanced design that lists many attractive mechanical features. Six automatic feeds in either direction, from 0.002 to 0.012 in., are set by a feed dial with readings graduated to 0.001 in. A half turn of the feed handle in either direction reverses the feed. Any speed from 35 to 180 strokes per minute is quickly obtainable, with speed changes quickly effected by simply turning a convenient hand wheel control.

The table, 8 in. wide by 8 in. long, has a vertical travel of 5½ in. and a 10½ in. traverse. The adjustable table support mounted on the base of the machine provides solid reinforcement to assure extra capacity on heavy cuts. Because the tool head may be swiveled 360 deg, squaring the ends of stock of almost any length is said to be possible on the Logan shaper. Full details and descriptive literature may be obtained upon request. **T-8-38**

Small Hole Gages

The Lufkin Rule Company, Saginaw, Mich., announces Small Hole Gages, either individually or in complete set —No. 78S—in range ⅛ to ½ in. These gages, designed for measuring diameters of small holes or widths of slots or grooves, operate as follows:



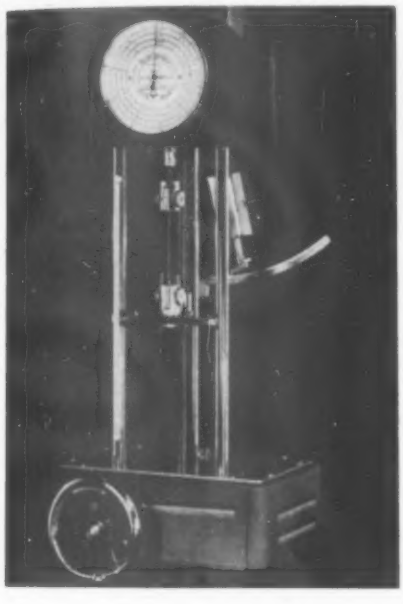
Insert the ball end of the proper size gage, in the hole or groove, turn the knurled knob until the right "feel" is obtained and then measure the ball end with a micrometer.

The change in size of the ball end is almost proportional to the movement of the knob and therefore aids in getting the proper setting and "feel". In addition, the radius of the ball end is always less than that of the hole being measured, thereby making only a 2-point contact. **T-8-39**

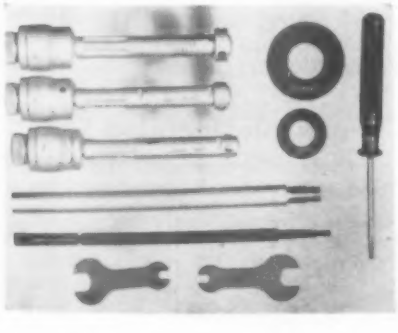
Multi-Low-Range Tester

A Universal Tester, with multiple low-ranges is announced by W. C. Dillon Company, Inc., 5410 W. Harrison St., Chicago 44, Ill. A hand-operated unit, it has a range of 0-100 lb., with scales 0-10, 0-25, 0-50 and 0-100 lb, in 1, 2, 4 and 8 oz. divisions respectively. Claimed accuracy is ½ of 1 percent. Calibration may be had in lengths of pounds, ounces, or kilograms.

The tester handles specimens in tensile, compression, transverse and shear. The indicator remains at peak load after a specimen breaks, with reset manual. The standard model has daylight opening 0-14-¾ in., however, taller units can be supplied with openings up to 48 in. **T-8-40**



Precision Inside Micrometers

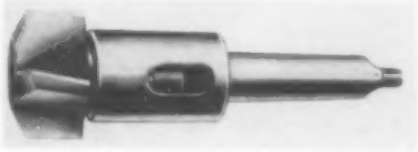


The Tesa Corporation, Switzerland, has appointed Wacker Sales Company, 35 E. Wacker Dr., Chicago, Ill., as Midwestern sales representatives for the Tesa Imicro Internal Micrometers. Thirteen of these micrometers, which measure to 0.0001 in., are required for range 0.500 in. to 4.000 in. The set illustrated has a range 0.500 in. to 0.800 in. Contact for measuring is made by three points of ease in centering and determining out-of-round conditions.

T-8-41

Interchangeable Core Drills

Scully-Jones and Company announces the addition of a Core Drill Cutter to their standard line of precision production tools. Available in 25 different sizes from 1½ to 3 in. in cutter diameter, this high-speed steel core drill cutter is said to remove approximately 45 percent of its diameter—that is, the 3-inch cutter will enlarge a 1⅝ in. hole to 3 inches. Only four holders are needed for the entire series of 25 sizes of cutters, helping to keep inventories at a low-cost operating minimum.



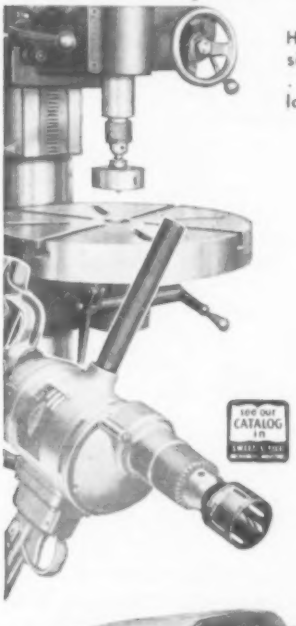
The cutters are 4-fluted and, as claimed, can be fed twice as fast as the 2-fluted twist drill. The narrow lands and small degree of back taper decreases friction, allows more power for profitable cutting, and, in addition, savings up to 48 percent are realizable by using the cutters in conjunction with counter-bore drivers in place of conventional 4-groove drills or standard twist drills.

Further information may be had from Scully-Jones and Company, 1915 South Rockwell St., Chicago 8, Ill. **T-8-42**

Cut...

LARGE HOLES

... thru any machineable material up to *ONE INCH* thick!



Here is a premium tool which makes it possible to saw holes in one short operation ... large holes which heretofore had to be laboriously machined "a-chip-at-a-time."

MARVEL High-Speed-Edge Hole Saws have strength to withstand the terrific peripheral strains of heavy duty operation in lathes, drill presses or portable power tools. They have a high speed steel cutting edge which is electrically welded to a tough, alloy steel body, high speed steel pilot drills, heavy hexagonal shanked arbors and sufficient set for deep drilling. They are self-aligning, as the larger diameter saws float on their arbors and are driven by double drive pins. They will saw round holes accurately in any machineable material.

MARVEL High Speed-Edge Hole Saws come in 35 sizes, from ⅜" to 4½". They are carried in stock by leading industrial distributors

WRITE FOR BULLETIN ST-49

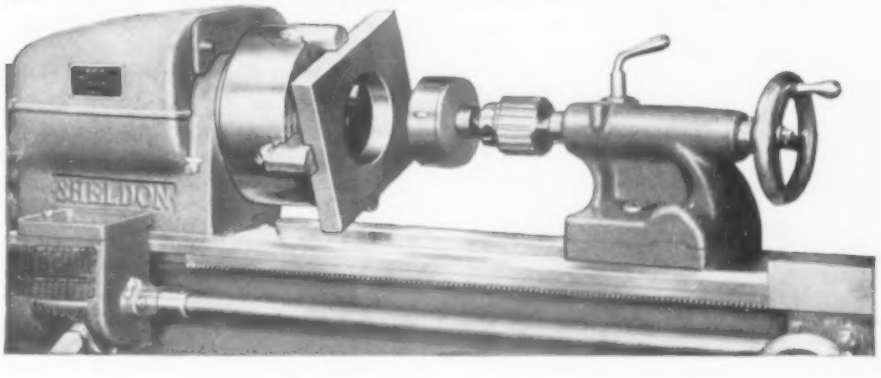
"MARVEL" *has Always had the edge!*

MARVEL Metal Cutting **SAWS**

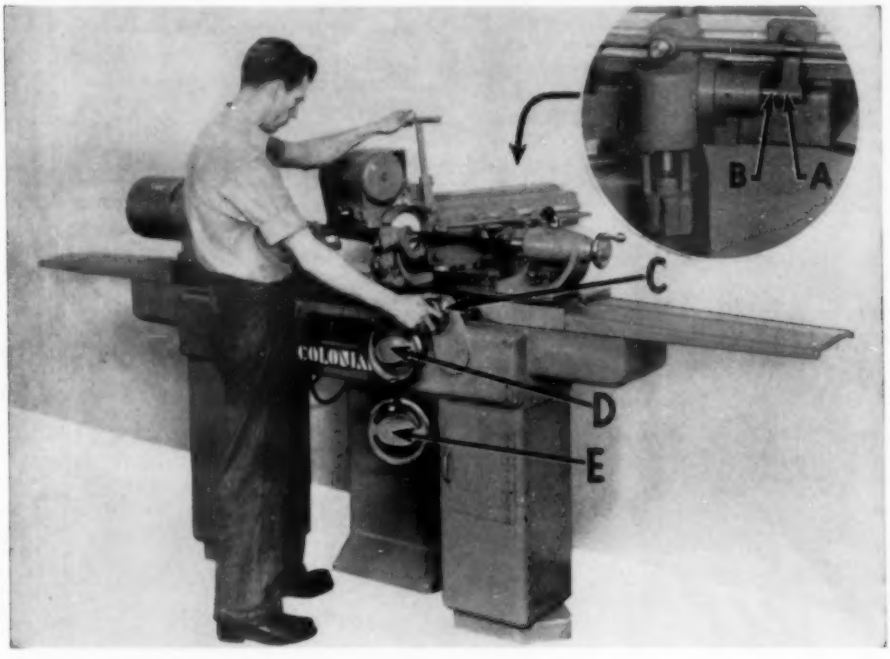
ARMSTRONG-BLUM MFG. CO.

"The Hack Saw People"

5700 Bloomingdale Avenue — Chicago 39, U. S. A.



Colonial Broach Adds Universal Sharpener



Designed for faster sharpening of both internal and surface broaches up to 36 in. in length, and 6 in. diameter, a Universal Broach Sharpener—Model No. CS-36—has been added to its line of seven sharpeners by Colonial Broach Company, Detroit 13, Mich.

A saving of up to 25 percent in sharpening time for various types of broaches—as round, serration, spline—is claimed for the machine as the result of an ingenious "step-stop" microfeed. This device functions as follows:

The broach is inserted between the motorized 2-speed headstock and the quick-release spring-loaded center tailstock. "Center point" steady rests provide center point support opposite the wheel and on underside of broach on all broaches up to 6 in. diameter. They are reradily adjusted to correct position.

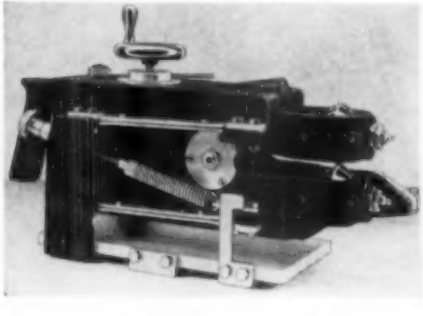
The "step-stop" micro-feed consists of a micro-feed handwheel (C) which controls the setting of a plunger (B) in the "step-stop" control Bracket A, when it contacts the plunger, limits the travel of the wheel when using the hand lever.

Setting of bracket A, for any broach, is made with the wheel at full depth on the largest diameter tooth on the broach and with the plunger all the way out. The additional feed required from tooth to tooth as the broach diameter decreases is provided by the micro-feed handwheel. Feed is approximately equal to the step per tooth. Hand-wheel D is for raising and lowering the head on the column.

To grind flat broaches, head and tail stock are replaced by a magnetic chuck. Head movement for flat broach sharpening is controlled by a second handle on the head. The purpose of providing two handles is to make operation as easy as possible for the operator when grinding either round or flat broaches. **T-8-43**

Continuous Limit Gage

Pratt & Whitney, Division of Niles-Bement-Pond Company, West Hartford, Conn., announces the Continuous Limit Gage which is designed to protect metal stamping dies from being injured by material that is too thick.



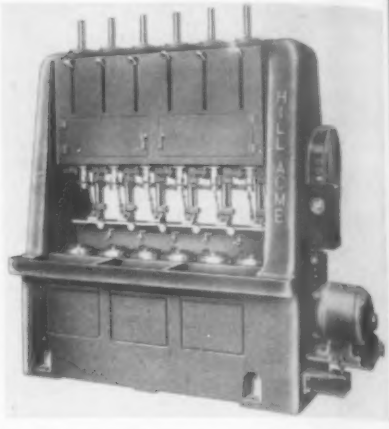
This gage does not show the thickness of the material or the amount of variation, but rather indicates when the material is light or heavy, not both.

When used with a die stamping press or similar machine, the gage will send out a signal or impulse that will stop the operation before the heavy material reaches the die. Also, it is said to provide an excellent means of inspecting continuous strip material where it is desired to control only one limit, high or low.

Range is from 0 to 0.300 in. with a claimed accuracy of 0.0005 in. The gage is readily set by means of precision gage blocks and by turning the hand wheel until the setting light is on or just ready to come on. **T-8-44**

Gang-type Tapping Machine

Among tapping machines manufactured by Acme Machinery Division, the Hill Acme Company, is the Model XC-W semi-automatic Tapping Machine, here shown adapted for tapping couplings. The same machine is also adaptable as a semi-automatic nut tapper.



This machine, which has enclosed working parts and is designed for faster operation and greater accuracy, works on a unique principle somewhat comparable to nut tapping. In the cycle of operations for tapping the couplings, for example, the cycle of operations is as follows:

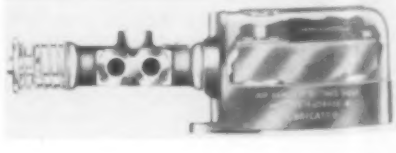
The coupling is placed on an air-operated chuck and a hand lever is depressed, closing the chuck. With this action, the spindle descends by gravity. Upon completing the tapping operation, the chuck opens, releasing the workpiece. The spindle returns to upper position with the tapped coupling on the shank of the tap.

When the shank of the tap—or taps, as here ganged—become filled with tapped parts, and the spindle idles in upper position, the taps are removed from the sockets and unloaded into chutes, located between the spindles, which carry the tapped parts to receptacles located at the rear of the machine. **T-8-45**

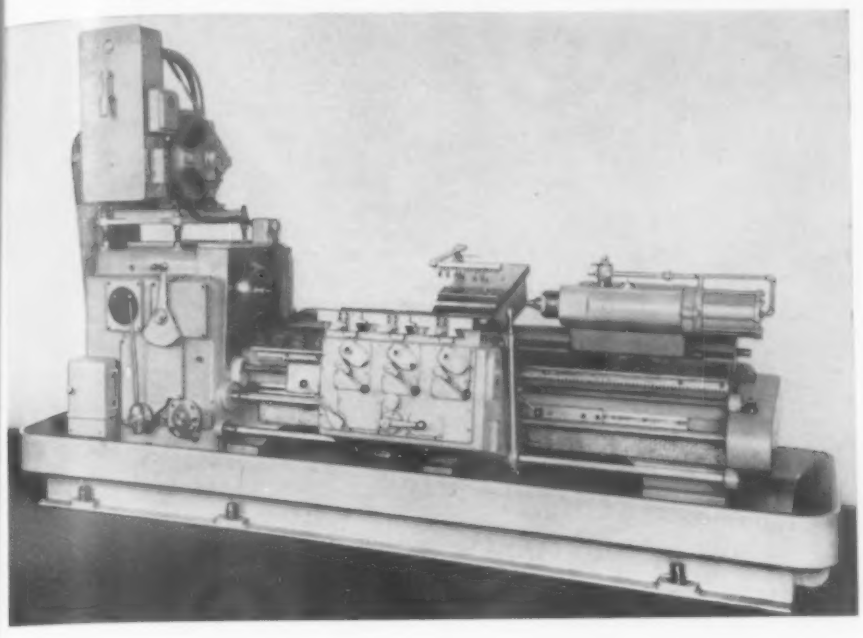
Solenoid-Operated Valve

Valvair Corporation, 454 Morgan Ave., Akron, Ohio, announces a line of single-solenoid Valves, for air pressures of 0 to 125 psi, in sizes ¼, ⅜ and ½ in., spring return. All sizes are available for 110, 220 and 440 volts in both 30-60 and 25 cycle current.

The valve has a one-piece bronze base, a powerful solenoid for positive seating, and shock-resisting clevis and pin. The following models are currently available in all sizes: 2-way; 3-way open and exhaust (normally closed only); 3-way piped exhaust, and 4-way piped exhaust. **T-8-46**



Shaft Turning Lathe With Longer Carriage Travel



Model "AP", the latest Lo-swing Lathe manufactured by Seneca Falls Machine Company, Seneca Falls, N. Y., is designed to fill the demand for a modern, high-speed multiple turning lathe which can be set up readily and operated by unskilled labor.

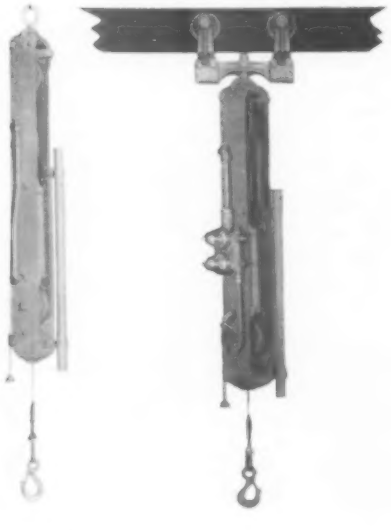
The multiple slide front turning carriage, on this semi-automatic lathe, operates on the rack and pinion feed principle to permit longer cuts than are possible with cam-operated closed-cycle lathes. Heavy stock removal with carbide tools is made possible by the balanced twin rack pinions meshing with heat treated steel rack and which cuts the unit tooth pressures in half.

The manufacturer, who recommends this ruggedly designed lathe particularly for shaft work involving long shoulder lengths where overlapping of cuts is not desirable, states that it is equally suited to short-run jobs where quantities do not justify setup time on fully automatic, closed-cycle machines.

Carriage cross slides are power operated and individually controlled, and hinged-type roller steady rests prevent work from springing away from the tools. Among other features are included automatic feed throwout coupled with automatic tool relief; rapid traverse movements for longitudinal carriage feed and cross slides; and manually-operated safety feed clutch which stops all carriage feeds in case of tool breakage. **T-8-47**

Suspension Tool Balancers

Operating on air line pressure of 100 lbs., a Tool Balancer by The Blatz Co., 20433 Sherwood Ave., Detroit 12, Mich., is manufactured in balancing ranges of 36 and 42 inches for balancing tools weighing from 10 to 500 lbs. The standard model is shown at left.



Suited especially for conveyor line assembling, the balancer may hang stationary from a fixed point, or, on movable trolleys running on T beam or commercial monorails. The suspended tool hangs within easy reach of the operator, who may lower it to working position with minimum effort. All balancers are designed to balance a specific weight plus or minus 2½ lbs., and plus or minus 15 lbs., depending on weight to be balanced. A safety latch holds the balanced tool at top of the balancing range when idle.

Also by Blatz is an Adjustable Weight Balancer, shown at right. Range corresponds with the standard balancer; however, this unit incorporates an adjustable pressure valve unit which permits balancing from 10 lbs. to a selected maximum. A feature of these balancers is that they do not consume air, just use the pressure. **T-8-48**

Cylinder Block Gage

A Cylinder Block Gaging Machine, developed by The Sheffield Corp., Dayton 1, Ohio, is a special Precisionaire designed to accurately check each of the bores in V-8 motor blocks at four different points. The operator manually stamps the classification for proper assembly.

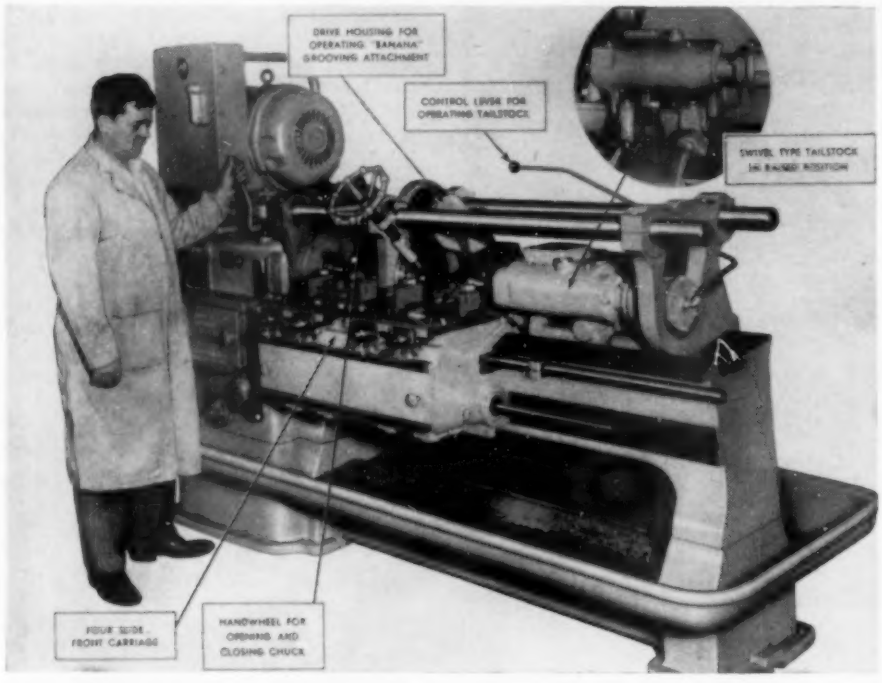
The cylinder block comes directly to the gaging machine on a roller conveyor, moves into position on a turntable and is then locked in the proper locating position by hydraulically actuated shot pins. The operator then lowers the four gaging spindles into the cylinder bores by pressing the electrical "down" button to start the inspection operation.

Should any of the spindles fail to enter the bores, a micro-switch will stop their downward travel instantly and signals—one for each spindle—will indicate interferences being encountered. The spindles are then retracted, a safety feature incorporated to prevent damage to them as well as to the cylinder blocks.

Each gaging spindle makes four separate checks in each bore, positions of floats in the 16 glass tubes indicating if each bore is within specified tolerance limits for taper and diameter. Classification is indicated in steps of 0.00025 in. By turning a handle directly under the glass tubes, the operator rotates the spindles 180 deg and obtains a full 360 deg check for out-of-round. He then stamps the information obtained on the block with symbols, using a manually operated device.

The gaging spindles are then retracted, the turntable is rotated 180 deg, and the same procedure is following to inspect the opposite cylinder bank. The shot pins are then released and the block is pushed onto the conveyor line by the next to be gaged. In connection with this machine, it is interesting to note that, in the plant where this machine is used, classification information is teletyped to the piston assembly area to facilitate making up sets of pistons to match each particular block as it comes off the assembly line. **T-8-49**

Lathe Turns Cam Shafts in Single Operation

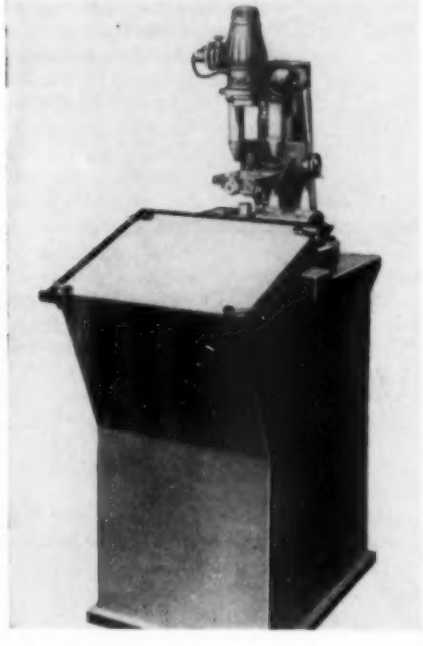

DRIVE HOUSING FOR OPERATING "BANANA" GROOVING ATTACHMENT
CONTROL LEVER FOR OPERATING TAILSTOCK
SWIVEL TYPE TAILSTOCK
FOUR SLIDE FRONT CARRIAGE
HANDWHEEL FOR OPENING AND CLOSING CHUCK

The Model "LR" Lo-swing automatic lathe shown turns and chamfers all bearings, oil pump gears and cuts interrupted oil or "banana" grooves in a single operation. This center drive lathe is equipped with a special two-jaw scroll chuck which clamps and drives the shaft from the cam located adjacent to number three bearing. The chuck jaws are opened and closed with a permanently mounted, gear type, hand wheel shaft. The air operated, swivel type tailstock is operated with two air cylinders, one of which swings the hinged upper section vertically, to permit easy loading and unloading in a line parallel with the centers, thus eliminating overhang of the tailstock center. The second air cylinder controls the movement of the spindle quill.

The "banana" grooving attachment is driven and timed from the main drive shaft and imparts a shuttle motion to the grooving tool slide, which is mounted—with other squaring tools—in a block on the rear slide. The driving head swivels on the chuck drive housing and follows the "feed in" and "feed out" movement of the rear slide. The "banana" grooves are always cut in definite relation to the chucked cam on the camshaft.

The Model "LR" Lo-swing automatic lathe is manufactured by the Seneca Falls Machine Co., Seneca Falls, New York. **T-8-50**

Profile Projector



Manufacturers of machines, tools, gauges, precision devices, watches and instruments, are offered a profile projector that can be used easily and quickly for checking and measuring at different magnifications and illuminations. The unit is distributed by Hauser Machine Tool Corp., Manhasset, N. Y.

Interchanging of parts for magnification or illumination purposes is eliminated—all optical parts are built in.

The condensers are built into a condenser head and correct illumination is chosen by a single turn of this head. A suitable condenser is provided for each magnification; this insures a maximum of light over the whole screen. The condensers produce a parallel beam of light on the objects and small focussing errors are therefore of no consequence for the accuracy of measurements.

Reading accuracy on the screen is approximately .004-.008 in. which, at a magnification of 100X, corresponds to an error on the object of .00004-.00008 in. **T-8-51**

Dryseal Pipe Plugs

The Allen Manufacturing Company, Hartford 1, Conn., announces two hex socket pipe plugs developed to eliminate the important causes of sealing failures. One, the Allen Dryseal Pipe Plug, is designed for use with dryseal taps and is to be used where a perfect seal is absolutely essential and where any sort of sealing compound might be unsafe or inadvisable. Particularly so where extreme pressures are involved. Accurate fit is assured by 360 deg roundness and by a perfect taper at both pitch and crest diameters.

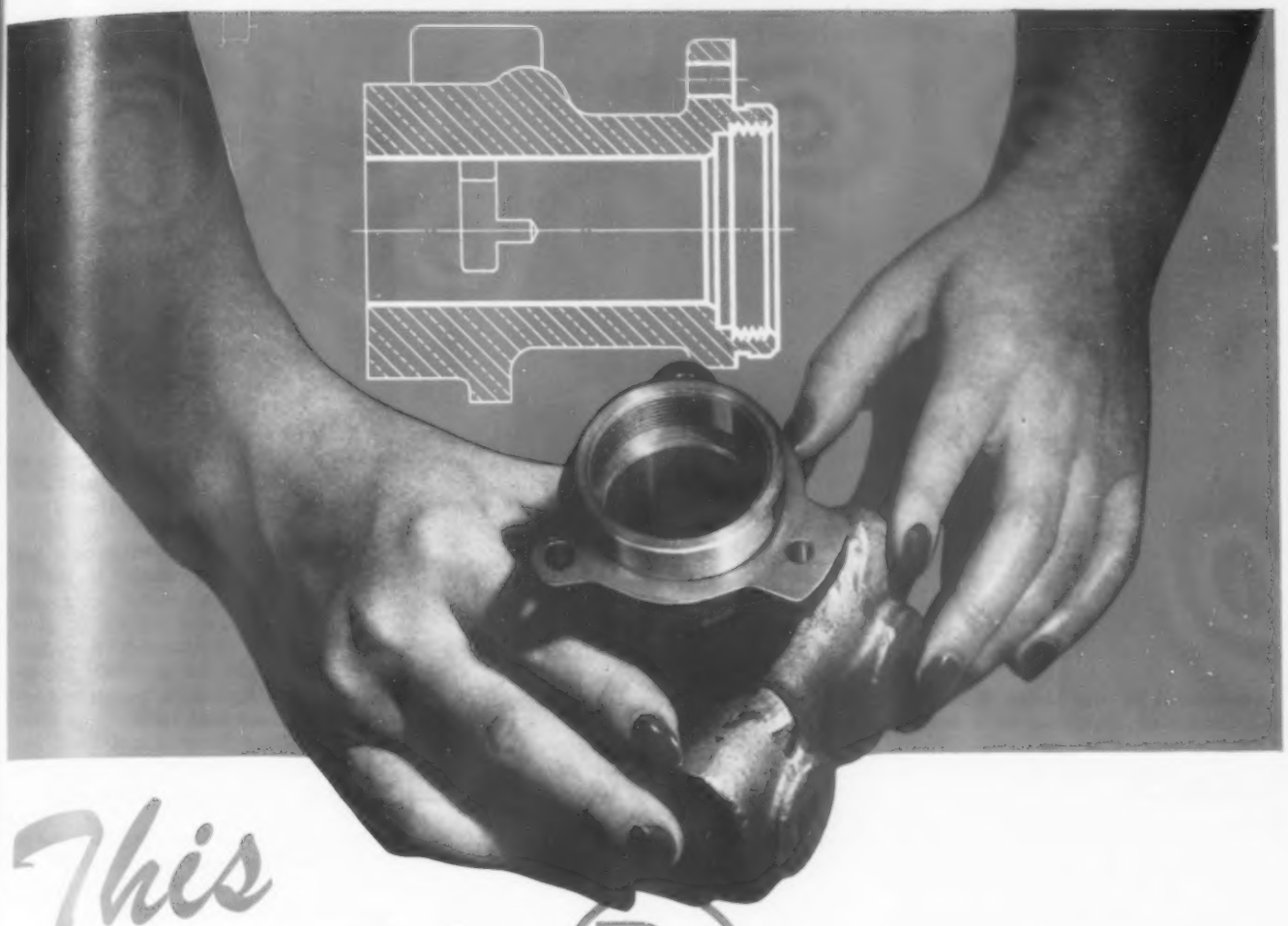
The standard pipe plug is threaded strictly in accordance with Army-Navy Aeronautical Specifications AN-P-363 and, because of precise roundness and smoother threads, may be used where a sealing compound is not ordinarily needed for pressure-tight joints.

The pipe plugs, which are available in sizes 1/16 to 1¼ in., are entirely pressure formed and threaded. Heads are cold drawn, to retain full strength of the metal fibres, instead of weakening the head by drilling and broaching. **T-8-52**

Improved Toggle Clamp

Addition of Model 225-U Toggle Clamp to the De-Sta-Co line is announced by Detroit Stamping Company, Finished Products Division, 328 Midland Avenue, Detroit 3, Mich. This tool has been developed to meet demand for a small, compact, clamping unit with clamping bar moving into a retracted, vertical position away from work as clamp is opened.

Advantages claimed include: Reamed working surfaces, stainless steel bearings, rugged construction and smooth, fast, powerful clamping action. Handle is designed for easy and safe operation. Clamp comes equipped with rubber tipped bolt assembly adjustable both horizontally and to work height, and is only 1⅞ in. high by 6½ in. long when bar is in horizontal work-holding position. **T-8-53**

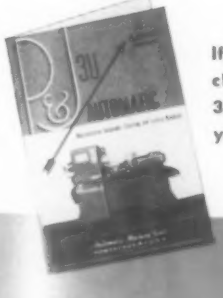


This IS THE RESULT OF P&J PRECISION TOOLING

— a pump housing, just as it comes from the P&J Automatic. Heavy lines in the drawing indicate the 17 exacting operations completed in record time with tungsten carbide P&J-engineered Tooling . . . boring, turning, facing, chamfering, reaming, threading . . . and a clever P&J multiple drill head setup for the three holes in the flanges.

The machine? It's the P&J 3U Speed Flex — smallest of the line of P&J Automatic Turret Lathes — which takes very little floorspace . . . operates with 48 changes of speed from 72 to 1420 rpm for the class of work up to 6" diameter . . . and features fully automatic operation to take fullest advantage of ingenious P&J Tooling.

Even if your work is beyond the 6" class, the skill and know-how of P&J Tooling specialists can work out a profitable tooling setup. Send us a sample part or prints, regardless of size, to prove how P&J Tooling will produce more quality parts with fewer rejects, at lower cost.



If your quantity production is within the 6" class, you will want this Bulletin on the P&J 3U Speed Flex Automatic. Just write for it on your Company letterhead.

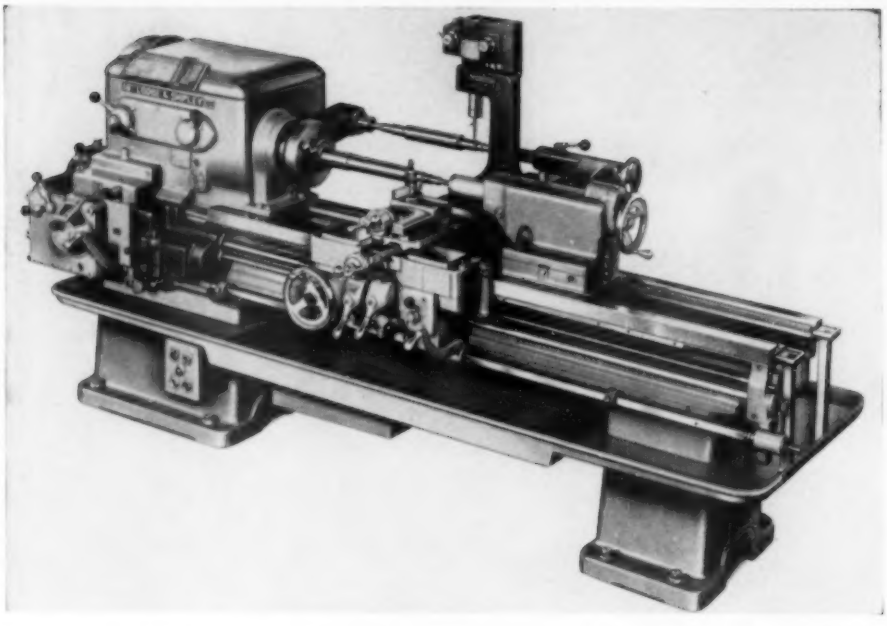
Potter & Johnston Company

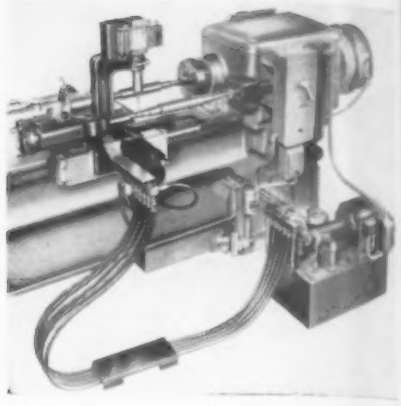
Pawtucket, R. I.

subsidiary of Pratt & Whitney Division Niles-Bement-Pond Company

PRODUCTION TOOLING HEADQUARTERS

Tracer Controlled Lathe





Announced by the Lodge & Shipley Co., Cincinnati 25, Ohio, is a tracer-controlled Dual-Purpose Lathe—known as the "Copymatic"—which embodies an all-hydraulic tracer control. The outstanding feature claimed for the lathe is the ease and facility with which the unit can be converted from standard lathe operation to automatic duplication and vice-versa. Changeover is accomplished by merely turning two valves and a switch. The lathe is illustrated in the large photo, while the smaller photo at right shows the all-hydraulic tracer control unit.

On duplicating work, the tracer will operate from round or flat templates, doing any type of turning or boring jobs within the range of the lathe equipped with tracer control. Reproduction of multiple diameter shafts with square shoulder faces, grinding necks, tapers in both directions, chamfers and curved contours as well as similar boring operations are said to be performed efficiently, quickly and to a very high degree of accuracy.

The hydraulic tracer equipment furnished on the "Copymatic" includes a hydraulic pump and motor, oil and air filter, tracer head and one stylus, valves and switches, hydraulically-operated clutch and brake for controlling longitudinal feed, hydraulic piston and cylinder for cross feed control and brake for controlling longitudinal feed, hydraulic piston and cylinder for cross feed control and supports for the templates.

Further details including description of operation, equipment and other interesting information are given in Bulletin No. 675, available on letterhead request. T-8-54

Use This Coupon for Complete Information On Tools of Today Items Featured This Month

For your convenience, a key number follows the announcement of each product reviewed in the *Tools of Today* section of THE TOOL ENGINEER. To obtain complete information on any of these products, circle the corresponding key numbers on this coupon, and mail the coupon to THE TOOL ENGINEER.

Tools of Today Department, THE TOOL ENGINEER
550 West Lafayette Blvd., Detroit 26, Michigan

Gentlemen:

Please send me further information on the following Tools of Today items which I have checked:

T-8-1 T-8-2 T-8-3 T-8-4 T-8-5 T-8-6 T-8-7 T-8-8 T-8-9 T-8-10
T-8-11 T-8-12 T-8-13 T-8-14 T-8-15 T-8-16 T-8-17 T-8-18 T-8-19 T-8-20
T-8-21 T-8-22 T-8-23 T-8-24 T-8-25 T-8-26 T-8-27 T-8-28 T-8-29 T-8-30
T-8-31 T-8-32 T-8-33 T-8-34 T-8-35 T-8-36 T-8-37 T-8-38 T-8-39 T-8-40
T-8-41 T-8-42 T-8-43 T-8-44 T-8-45 T-8-46 T-8-47 T-8-48 T-8-49 T-8-50
T-8-51 T-8-52 T-8-53 T-8-54

Name .....

Position .....

Firm .....

Street..... City, State.....

get this new book

A TECHNICAL ANALYSIS OF FAST INDEX HOBS

"Faster Gear Production"

"Faster Gear Production" is a new 20 page booklet prepared by Illinois Tool Works. It presents a careful, thorough analysis of the advantages of Fast Index Hobs and the opportunities for exploiting the full production capacity of your present machine tools. Technical data on finishes, performance characteristics and comparative rates of production in various types of applications are discussed. You will find this specific information, based on actual experience, genuinely helpful—send for your free copy today!

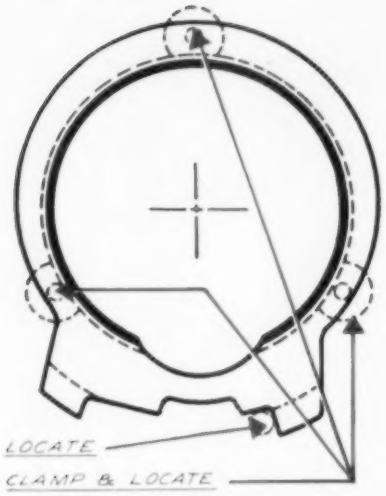
ILLINOIS
TOOL WORKS
2501 North KEELER AVE., CHICAGO 39, ILLINOIS
In Canada: Canada Illinois Tools, Ltd., Toronto, Ontario

HEADQUARTERS FOR ENGINEERED CUTTING TOOLS

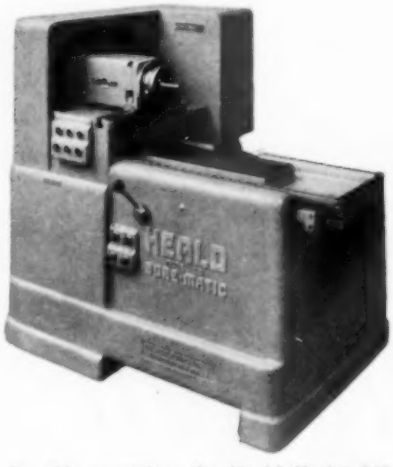
Production of Overdrive Balk Rings

INCREASED FROM 1200 TO 2000 PIECES PER SHIFT

...on a New Heald Model 221 Bore-Matic



Detail of overdrive balk ring, showing clamping and locating arrangement and surfaces bored and chamfered in a single high-speed automatic cycle.



For this operation, the Heald Model 221 Bore-Matic is equipped with a two-station hydraulic clamping fixture, dual boring-heads, and special feed-out quills, as shown below.

When this new Heald machine took over the job of borizing overdrive balk rings, production went up almost 100 per cent. What's more, the customer reports that the operator and foreman are greatly pleased with the equipment—because it's easier to operate, easier to set tools, easier to load and unload. And they particularly like the efficient guarding that keeps the coolant from spattering up the machine and the operator.

This Model 221 Bore-Matic is arranged with a quick-acting hydraulic clamping fixture for boring and chamfering two parts simultaneously. An unusual feature of this machine is the unique feed-o quill arrangement. As the table trav to the left, the quills bore and plun chamfer on the back side of the pa Then, when they have traveled beyo the bore, a stud in the fixture pushes the back and outward to chamfer the fro side of the part. The table then revers and the quills automatically retract, bo ing again on the return table stroke.

If you have a precision finishing pro lem, in either borizing or grinding, w not let Heald engineering and experien help you do the job faster, easier, and lower cost. Your nearest Heald represe tative is at your service.

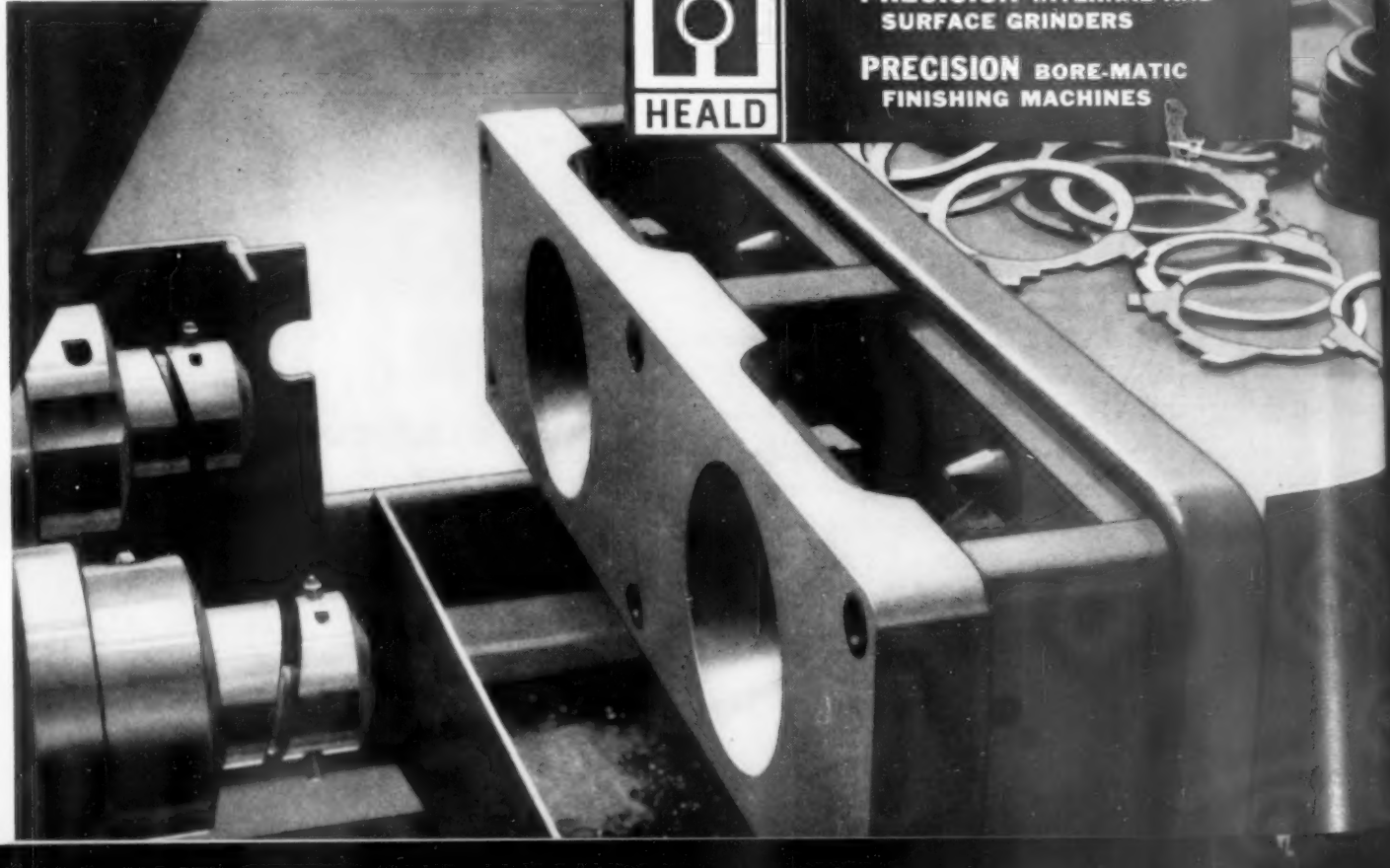
THE HEALD MACHINE COMPANY, Worcester 6, Mass.

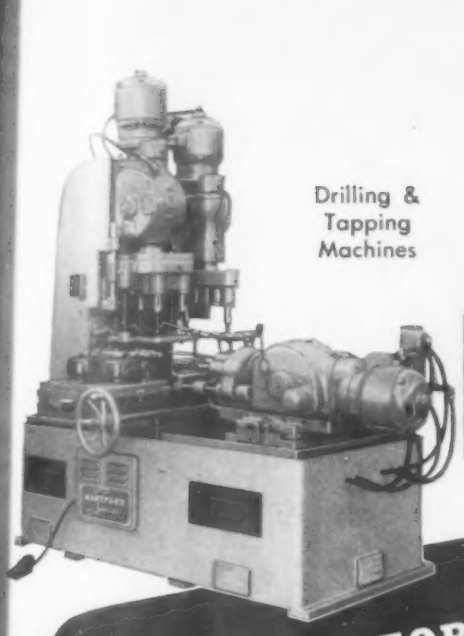
Branch Offices in Chicago • Cleveland • Dayton • Detroit • Indianapolis • Lansing • New York

HEALD

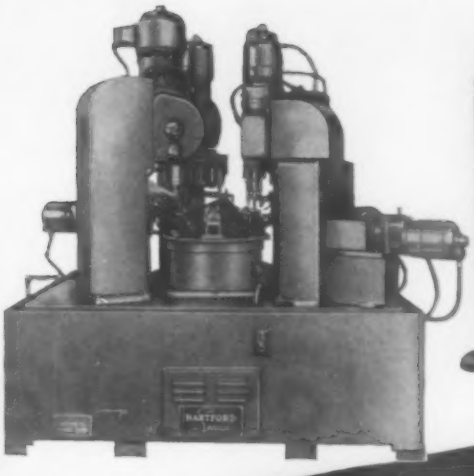
PRECISION INTERNAL AND SURFACE GRINDERS

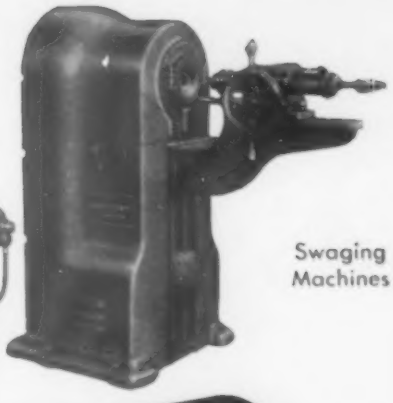
PRECISION BORE-MATIC FINISHING MACHINES





Drilling & Tapping Machines





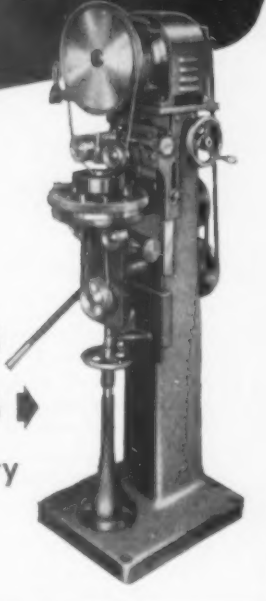
Swaging Machines

THE HARTFORD SPECIAL MACHINERY CO.
HARTFORD, CONNECTICUT

now producing the standard line of

DRILLING & TAPPING MACHINERY
SWAGING MACHINES

formerly manufactured by
LANGELIER MFG. CO.
Cranston, R.I.



in addition to our

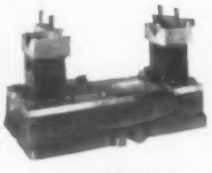
Automatic THREAD ROLLERS
DIE POLISHING MACHINES

and complete line of special machinery built to specification

We also manufacture exclusively these famous shop aids

"Super-Spacers"

"Four-Point" Milling Vises



"V-Block" Milling Fixtures

HARTFORD *Special*

...the standard for special machinery

IT'S A

Mac-it®

PRONOUNCED "MACK-IT"

Mac-it Hollow Pipe Plugs — for accuracy, safety, uniformity and strength.

BETTER, FASTER SERVICE WITH THIS *COMPLETE* MAC-IT LINE!

Because many standard types of Mac-its are stocked throughout the country for quick delivery, and because specials can be engineered to your own specifications, you'll find it pays to investigate Mac-its *first.*

Mac-it's 35 years' experience in the manufacture of heat-treated, alloy steel screws is your assurance of precision, uniformity and strength. Sold through leading industrial distributors from coast to coast and in Canada. Write for new catalog today!

Other Mac-it products include:

- Hollow Lock Screws
- Socket Head Cap Screws
- Hollow Set Screws
- Stripper Bolts
- Socket Screw Keys
- Square Head Set Screws
- Hexagon Head Cap Screws
- . . . and many others

Marketed Nationally Since 1913 by

STRONG, CARLISLE & HAMMOND COMPANY

Cleveland 13, Ohio

Manufactured by MAC-IT PARTS COMPANY, Lancaster, Pa.

Machine MULTIPLE DIAMETERS-

in ONE OPERATION

with SUBLAND TOOLS

and Cut Production Costs

As an example: the tool pictured at left, above, reams and counterbores a 1.375 hole, forms a radius and reams a 1.750 hole *all in* one operation —plus the economy of easy resharpening and extended tool life available with subland design. Check and see if a subland tool, designed and built under Fuller supervision, will not cut production costs for you.

"BETTER" if it's made by FULLER!

SKILLED CRAFTSMEN

FULLER TOOL *Co.*

SPECIAL TOOLS • PRECISION MACHINING

GUILD

3956 WEST ELEVEN MILE ROAD

BERKLEY • MICHIGAN

Telephone LINCOLN 2-5600

SPECIAL CUTTING TOOLS MADE PROMPTLY . . .

Accurately

CARBIDE TIPPED OR H.S. STEEL

Special cutting tools of all types are a specialty at Detroit Reamer & Tool Company. All carbide-tipped tools are supplied with high speed steel bodies.

Included in our modern equipment are Circularity-Grinding Attachments. Circularity relief can be ground on any special tool, when specified, at no additional cost.

Our engineering department is at your disposal to help solve cutting tool problems.

D R & T COMPANY

DETROIT REAMER & TOOL CO.

Mfrs. of Special High Speed Cutting Tools

2830 East 7 Mile Rd. Detroit 12, Michigan

To help you take full advantage of more efficient machines and new materials, Brown & Sharpe engineers are constantly testing and developing new designs in cutters. In the development of the most practical cutters, diversified manufacturing in Brown & Sharpe's own plant provides an exhaustive testing ground.

Brown & Sharpe cutters have many advanced features of design that permit highly efficient operation. Their dependable performance assures *more* as well as *better* work.

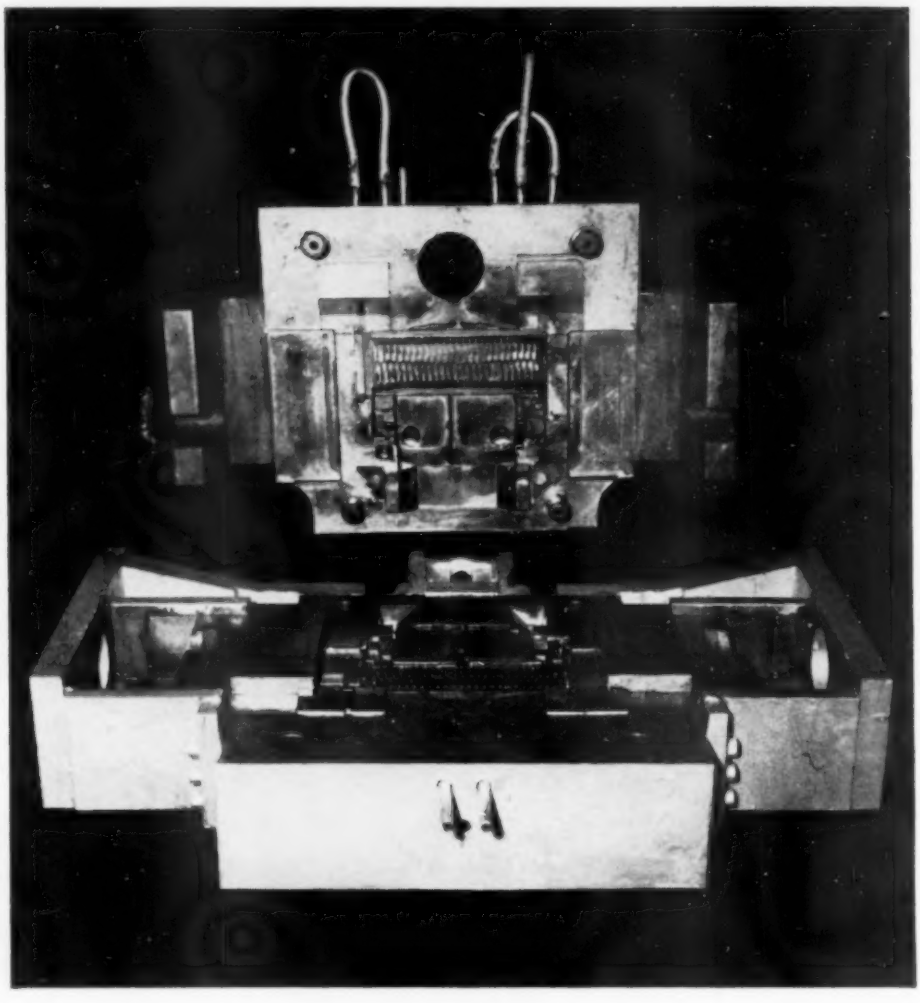
Get fully acquainted with all the advantages of Brown & Sharpe cutters—they cost you less in the long run. Brown & Sharpe Mfg. Co., Providence 1, R. I., U. S. A.

• A COMPLETE LINE OF MILLING CUTTERS

Plain Milling
Helical Plain Milling
Side Milling
Staggered Tooth Side Milling
Inserted Tooth
Angular
Convex and Concave
Screw Slotting
Sprocket Wheel
Gear
End Mills
Metal Slitting Saws

We urge buying through the Distributor

BROWN & SHARPE CUTTERS B·S



And it doesn't have to be **TYPEWRITERS** you're die casting!

Accuracy calls for POTOMAC M

HOT-WORK DIE STEEL

"HOT-WORK STEELS"

is the title of a new, six-page folder that tells about the chromium, molybdenum, vanadium Hot Die Steel known as POTOMAC M—and also covers other grades for other hot-work operations. Secure your copy —*write today!*

ADDRESS DEPT. TE-78

In the precision casting of aluminum, POTOMAC M Hot-Work Die Steel is especially favored as the material for die-casting dies because its properties help assure accuracy of the steel itself *after* heat treatment. Die makers have found that size changes are held to a minimum.

Dimensional stability is thus the *first* contribution that POTOMAC M makes to accuracy.

Production accuracy of the die after it is in service is maintained also by the resistance of POTOMAC M to wear, to heat checking, and to metal wash.

Allegheny Ludlum makes a complete line of steels for hot-work tooling of various kinds—so, whether your need is the mass producing of duplicate parts or fabricating a few of them, call up "A-L" every time for hot-work counsel or service or both. Tell us your requirements.

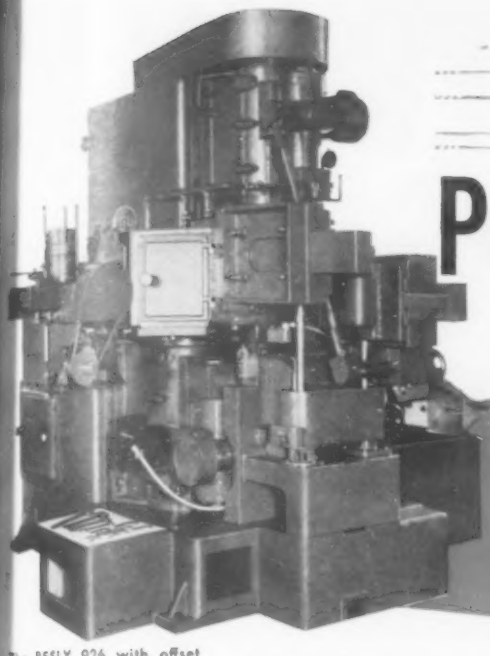
ALLEGHENY LUDLUM
STEEL CORPORATION
Pittsburgh, Pa.

TOOL STEEL DIVISION: DUNKIRK, N. Y.

Fine Tool Steels Since 1854

AL

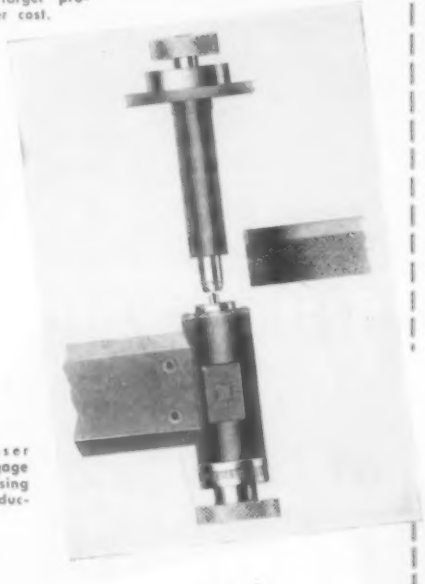
W&D 2484



The BESLY 926 with offset heads — for larger production at lower cost.

NON-STOP Production Booster!

This BESLY Grinder Saves Time... Cuts Costs!



The dresser arm and gage — for dressing while producing.

Grinding your jobs *Non-Stop* on a BESLY 926 Production Grinder (As illustrated) means considerable savings in your production costs. Less time is required to run a job because interruptions for dressing operations can be entirely eliminated.

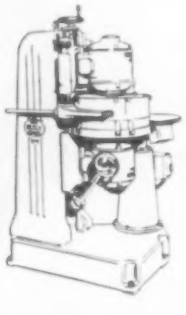
This heavy duty, vertical, double spindle grinder is equipped with offset grinding wheels and two powered dresser arms. Built-in gages permit dressers to be set exactly to work size requirements. Once the dressers are set and a job started, there are no interruptions. You can dress both the upper and lower grinding wheels while you finish your jobs... *Non-Stop!*

In addition to stepped up production, you can expect superior results in other ways. Features like the three-way adjustable heads, hydraulic spindle feeds and the exclusive angular set wheels with Besly's "Progressive Grinding Principle" all contribute to the extreme accuracy and remarkable uniformity of output which characterize the performance of this grinder.

For grinding parallel surfaces accurately on small parts such as bearing races, oil seals, thrust washers, snap rings, coil springs, etc., you can be sure the BESLY 926 is built to do the job. Write today for complete data and illustrated literature. Learn how the advantages of BESLY Grinders will benefit you *productionwise.*

10 TIMES MORE OUTPUT —COSTS DOWN!

After installing a BESLY 926 equipped with offset wheels using 30"x14"x1" BESLY Titan Abrasive Discs, a prominent automotive parts manufacturer boosted production figures on piston rings by more than ten times to over 12,000 pieces per hour with a sharp decrease in costs. Tolerances are held to .0002" for size, .0001" for parallelism and from 6 to 9 micro inch finishes.



BESLY manufactures a complete line of vertical and horizontal double spindle production grinders, vertical and horizontal all purpose disc grinders and are designers and builders of equipment for special applications. No matter what your grinding problem may be, there is a BESLY to serve you better. And for improved grinding finishes always order BESLY Titan Steelbac Abrasive Discs.

Maybe GRINDING is the Better Way . . . Better Check with

BESLY

ESLY GRINDERS AND ACCESSORIES
ESLY TAPS • BESLY TITAN ABRASIVE WHEELS

CHARLES H. BESLY AND COMPANY • GRINDER SALES and MANUFACTURING • BELOIT, WIS.

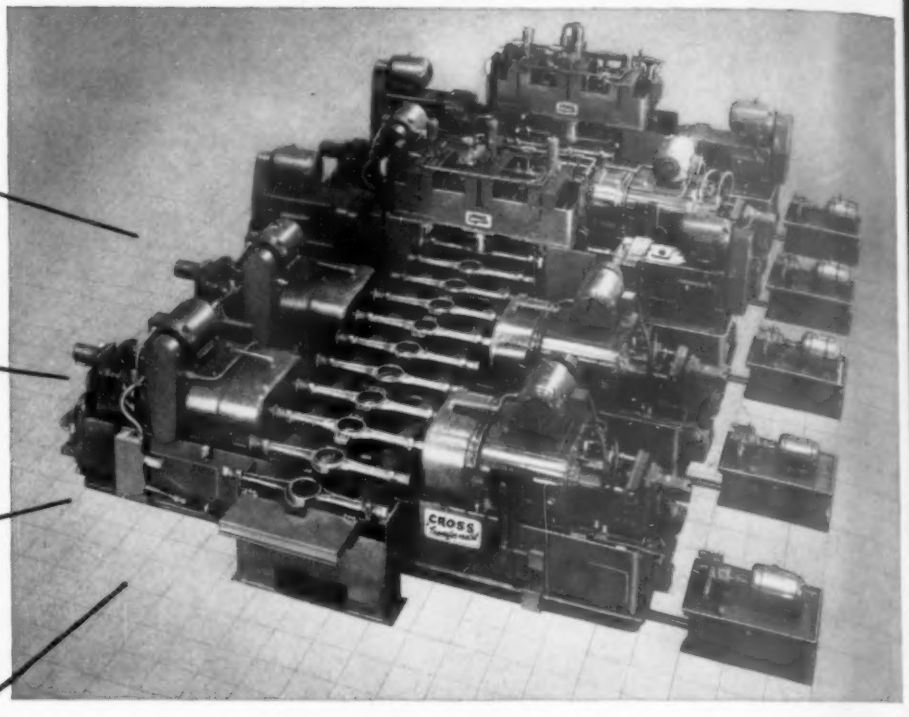
CROSS TRANSFER-MATIC

150 AXLE HOUSINGS PER HOUR WITH 1 OPERATOR

LOWER CAPITAL INVESTMENT

EXCEPTIONAL FLEXIBILITY

SIMPLIFIED MAINTENANCE



Another cost-cutting application of VICKERS HYDRAULICS

The Cross Transfer-matic illustrated here uses Vickers Hydraulic Controls in making substantial reductions in the cost of machining axle housings.

A hydraulic transfer mechanism automatically advances the housings (two at a time) from one machine to another. Hydraulic circuits of the individual machines provide for correct progressive positioning and clamping together with the traversing and feeding of the tool slides. Interlocks assure accurate positioning and secure clamping before cutting operations begin . . . also clearance of all tools before transfer to next station.

Exceptional flexibility is provided in that machines can be added, removed or shifted. Transfer mechanism is independent and moves work only from machine to machine. Locating and clamping are done by work holding fixtures integral with each machine.

Indicative of the many advantages of Vickers Hydraulics are gasket mounted Vickers Control Valves that simplify installation, save space and make adjustment easier. Vickers Power Units are compact "packages" that simplify hydraulic system design and reduce costs.

Vickers Hydraulics are particularly adapted to provide the complex motions and operations needed in highly automatic machines. Get in touch with the Vickers Application Engineering Office nearest you for information on how Vickers Hydraulics can improve your machinery.

Representative Vickers Hydraulic Pumps and Controls Used on Cross Transfer-matic

Power Unit, Bulletin 46-43a

4-Way Valve, Pilot Operated, Solenoid Controlled, Bulletin 48-27

Flow Control Valve, Bulletin 45-35

Sequence Valve

Check Valve

Pressure Reducing Valve

3989

VICKERS Incorporated

DIVISION OF THE SPERRY CORPORATION

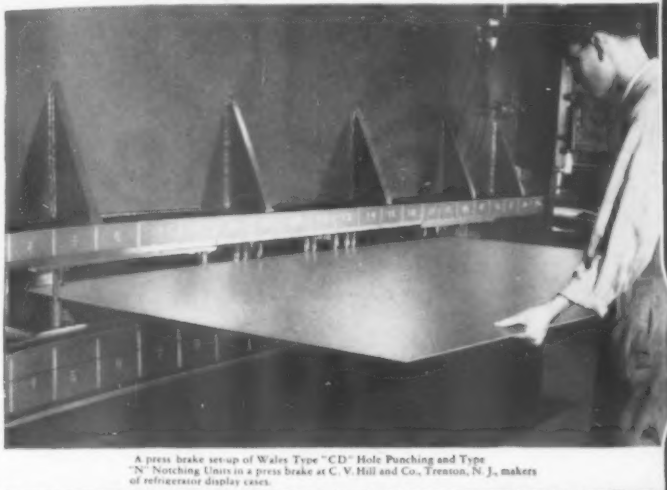
1416 OAKMAN BLVD. • DETROIT 32, MICHIGAN

Application Engineering Offices:

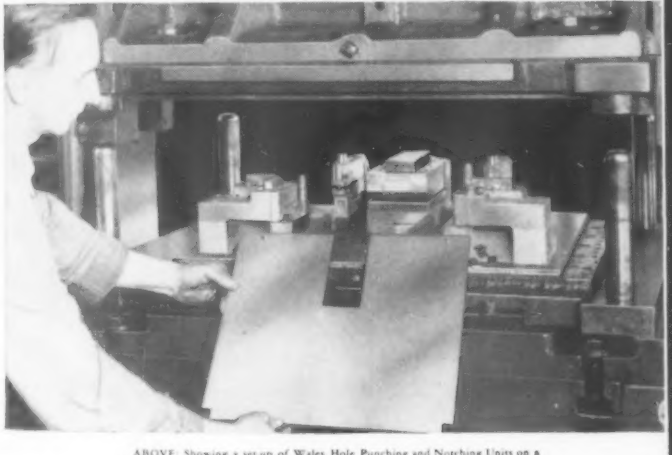
ATLANTA • CHICAGO • CINCINNATI • CLEVELAND • DETROIT • LOS ANGELES • NEWARK • PHILADELPHIA • PITTSBURGH • ROCHESTER ROCKFORD • ST. LOUIS • SEATTLE • TULSA • WASHINGTON • WORCESTER

ENGINEERS AND BUILDERS OF OIL HYDRAULIC EQUIPMENT SINCE 1921

Wales Hole Punching Units in operation at the Bush Manufacturing Co., West Hartford, Conn., makers of a complete line of refrigeration equipment.

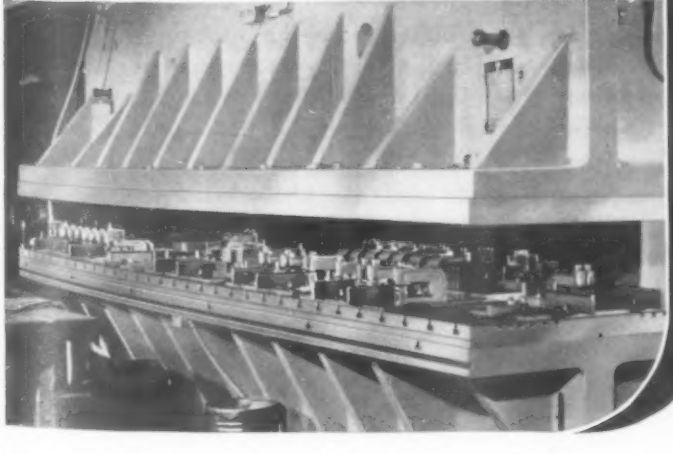


A press brake set-up of Wales Type "CD" Hole Punching and Type "N" Notching Units in a press brake at C. V. Hill and Co., Trenton, N. J., makers of refrigerator display cases.



ABOVE: Showing a set-up of Wales Hole Punching and Notching Units on a template in a stamping press for the Norge Division of Borg-Warner.

BELOW: A double set-up of Wales Hole Punching Units on an extra wide T-slotted rail in a press brake at McCray Refrigerator Co., Kendallville, Indiana.



IN THE REFRIGERATION INDUSTRY

nothing can be simpler than

WALES

HOLE PUNCHING AND NOTCHING EQUIPMENT

● Exclusive simplicity of set-up methods, reuse of the same units in unlimited patterns, permanent alignment of punches and dies, are a few of the many reasons why refrigerator and refrigeration equipment manufacturers standardize on Wales Equipment.

IF YOU PUNCH OR NOTCH angles, channels, extrusions or sheets in stamping presses or press brakes, investigate and compare Wales Equipment with any other method.

YOU, TOO, WILL STANDARDIZE on Wales Equipment because *no other hole punching and notching equipment compares with it.*

IT IS TOO BIG A STORY to tell on this page . . . so write *today* for fully-illustrated, functionally colored catalogs.

TYPICAL USERS OF WALES EQUIPMENT AMONG REFRIGERATION MANUFACTURERS

Ebco Mfg. Co.	Servel, Inc.
Fogel Refrigerator Co.	The Super-Cold Corp.
General Electric Co.	Tyler Fixture Corp.
Kramer Trenton Co.	Uniflow Manufacturing Co.
Peerless of America, Inc.	United Refrigerator Mfg. Co., Inc.
Noma Electric Corporation Refrigerator Div.	Viking Refrigerators, Inc.
	Westinghouse Electric Corp.

WALES-STRIPPIT CORPORATION

George F. Wales, Founder

393 Payne Avenue, North Tonawanda, N. Y.

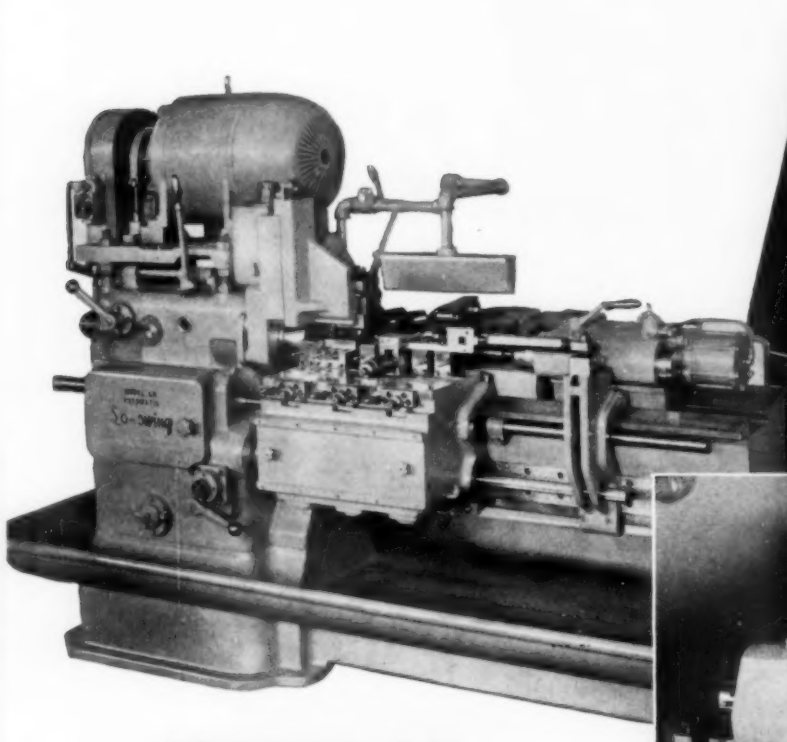
(Between Buffalo and Niagara Falls)

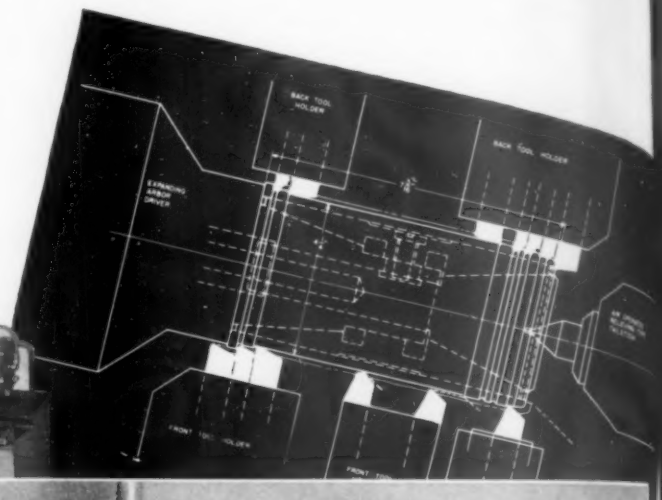
WALES-STRIPPIT OF CANADA LTD., HAMILTON, ONTARIO

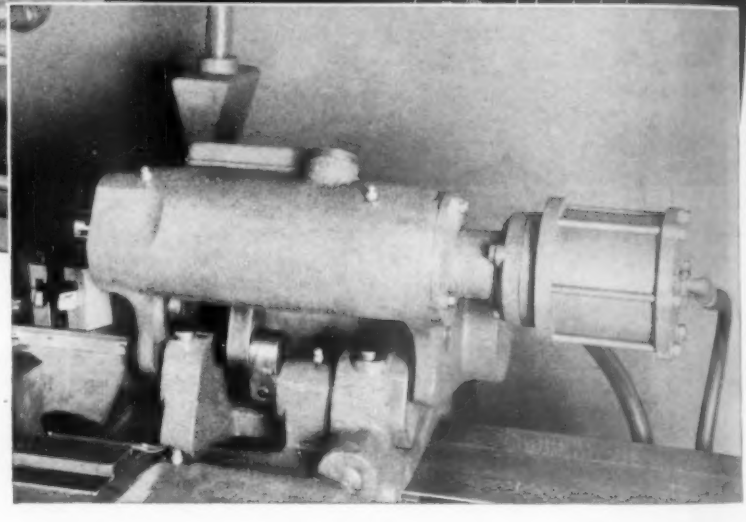
Specialists in Punching and Notching Equipment

MACHINE OF THE MONTH

PREPARED BY THE SENECA FALLS MACHINE CO. "THE Lo-swing PEOPLE" SENECA FALLS, NEW YOR







MODEL LR Lo-swing LATHE SPEEDS PRODUCTION ON CYLINDER LINERS

Problem: To automatically turn outside diameters, face and groove cast iron Cylinder Liners of various types with Carbide Tools.

Solution: Model LR Lo-swing Automatic Lathe was selected for this job because of its demonstrated fine performance with carbide tools, and its ease of setting-up due to its Simplified Change-Over Mechanism. A Relieving Tailstock which minimizes tailstock spindle overhang, and which facilitates loading and unloading, was incorporated.

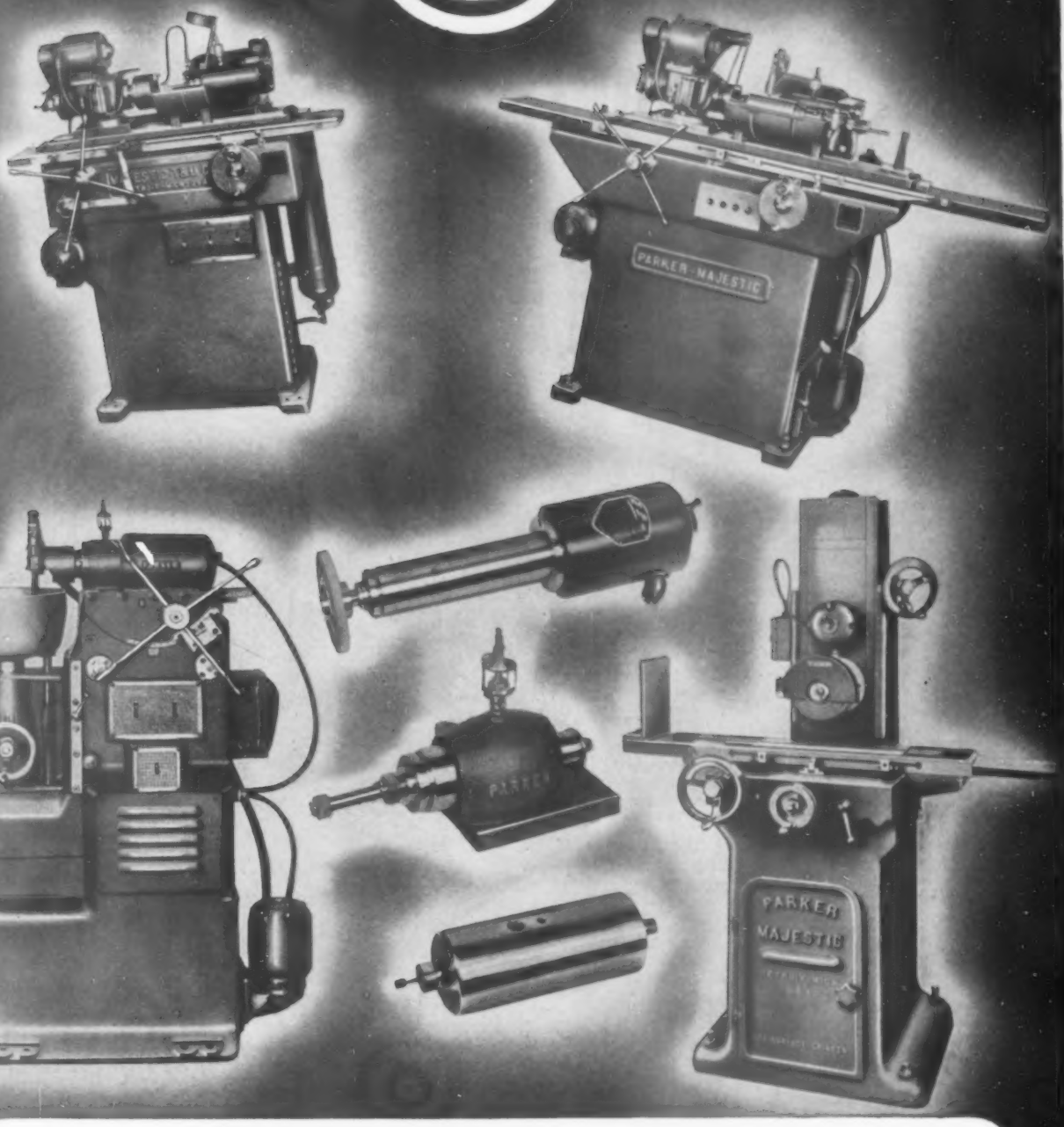
The cast iron cylinder liners are delivered to the Lathe with the bore machined to size and the large end faced. They are held and driven with an air-operated, expanding collet arbor which extends the full length of the piece. This large area driving surface permits the high cutting speeds and coarse carriage feeds required for fast production. Loading of the parts is simplified with the Relieving Type Tailstock, shown in the close-up illustration. Since the driving arbor is bolted to the spindle nose, the operator is relieved of handling heavy stub arbors generally used when work is held between centers. The outside diameters and the short taper on the tailstock end of the liners are turned with six tools mounted on the front slides; all facing and grooving operations are accomplished with tools mounted on the rear slide. The entire operation is automatic—the operator simply loads and unloads the parts and pushes the starting button.

Seneca Falls engineers are at your disposal to assist you with your turning problems.

SENECA FALLS MACHINE CO., SENECA FALLS, N. Y.

PRODUCTION COSTS ARE LOWER WITH Lo-swing

PRECISION MACHINES PM PARKER • MAJESTIC



Since 1907, the name of Parker has been a part of the progress of the automobile industry.

In 1915, Parker introduced the basic principle of ball bearings in grinding manufacture—a major advance in grinding which was unknown at that time.

A few years later the Parker Ball Bearing was patented to meet high speed and precision requirements and has been in use ever since.

Further research and engineering development brought forth the well-known Parker Majestic External and Internal Grinding Machines, each machine representing a great advance in simplicity of operation and precision.

The latest tooling development of the company is the Parker Majestic No. 2 Surface Grinder that provides new accuracy and flexibility for small grinding operations.

These many products of Parker Majestic will continue to serve the great automotive industry in the future, keeping pace with its demands for speed, accuracy and dependability.

MANUFACTURED BY

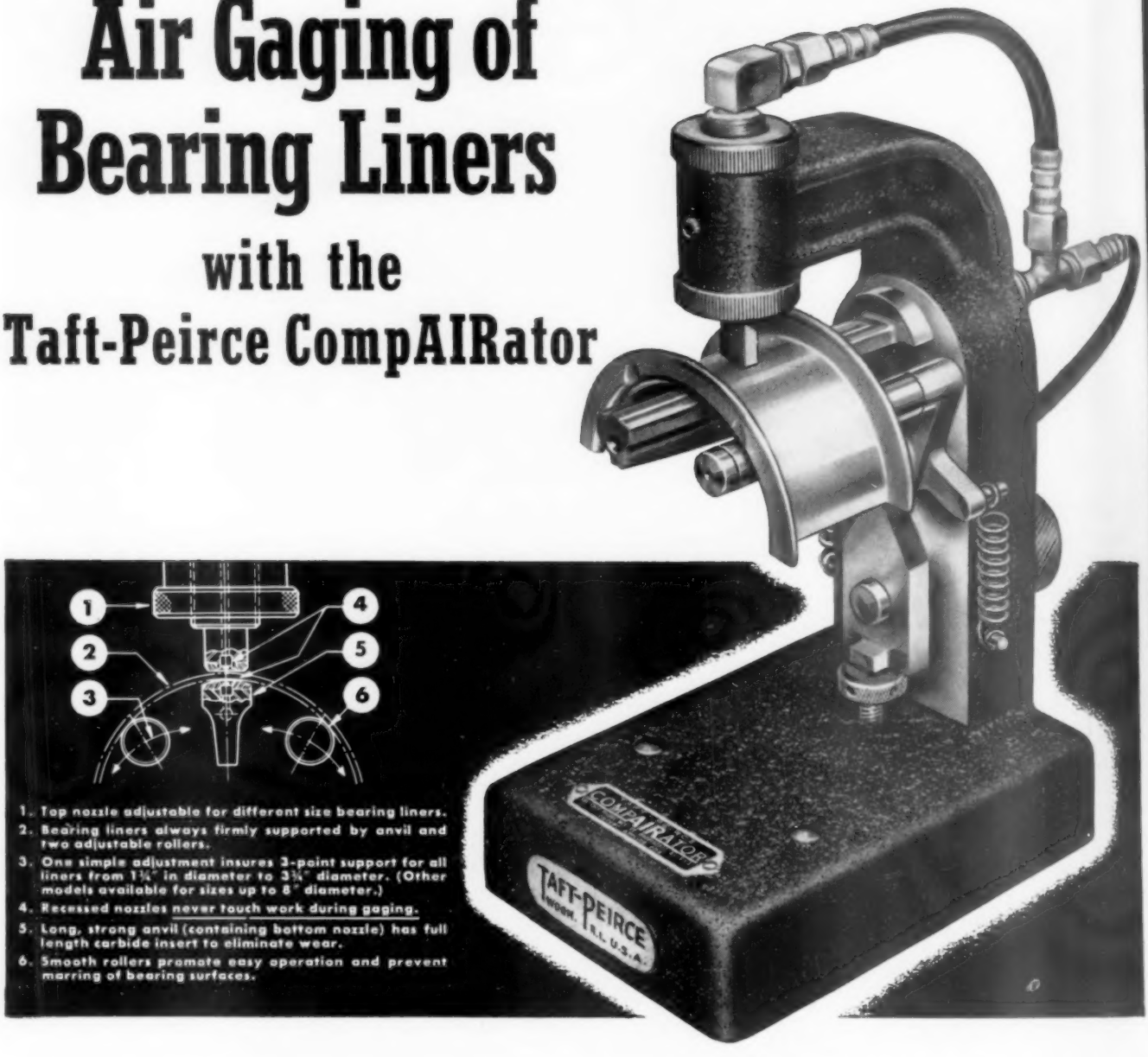
MAJESTIC TOOL AND MANUFACTURING COMPANY

147 JOS CAMPAU • DETROIT 7, MICHIGAN

NOW...

Air Gaging of Bearing Liners

with the Taft-Peirce CompAIRator



1. Top nozzle adjustable for different size bearing liners.
2. Bearing liners always firmly supported by anvil and two adjustable rollers.
3. One simple adjustment insures 3-point support for all liners from 1¼" in diameter to 3¾" diameter. (Other models available for sizes up to 8" diameter.)
4. Recessed nozzles never touch work during gaging.
5. Long, strong anvil (containing bottom nozzle) has full length carbide insert to eliminate wear.
6. Smooth rollers promote easy operation and prevent marring of bearing surfaces.

Here's another example of the versatility and effectiveness of the Taft-Peirce CompAIRator. It's a special air gaging fixture which we designed to check the wall thickness of bearing liners. When connected to a standard Taft-Peirce CompAIRator, this device provides a rapid and accurate means of exploring the entire bearing area for variance in wall thickness.

Adjustable for different diameters and wall thicknesses, these fixtures are being adopted for faster and more economical inspection service by leading bearing liner manufacturers. There's no need for clamping, with its attendant delays and distortion, since two recessed nozzles are applied. These never touch the work. Tungsten carbide wear strips assure extensive life.

Maybe some of your tricky inspection problems can be licked by the Taft-Peirce CompAIRator. Our air gaging engineering service is available for analysis of your particular requirements.

For full information, write or phone your local Taft-Peirce representative or address "Department TE"

The Taft-Peirce Manufacturing Company
Woonsocket, Rhode Island

Universal Standard Drill Bushings with **super finish I.D.** lengthen the bushing life . . . reduce tool breakage . . . slash drill wear. Then, add the plus features of blended radius, knurled head, I.D. break, chamfered O.D., and you have the reasons why Universal Drill Bushings are specified by many of America's largest manufacturers. All catalog sizes are available for immediate shipment. Extra prompt sectional delivery and information are provided by warehouses at 1060 Broad Street, Newark, New Jersey, and 5035 Sixth Ave., Kenosha, Wisconsin. Write, call or wire today!

Facilities available for special hardened and ground precision parts made to customer specifications.

A note on Abrasives

The Advantages you get from "Advanced" Technical Research

During the war, a shortage of bonding material, used in making grinding wheels, developed. This situation could have presented a serious problem... except for the fact that it had been anticipated. A substitute had been largely developed in advance by our researchers and now was rushed into service. Not only did it fill the immediate need...it proved superior and continues in current use.

In developing and producing better abrasives, science and production agreed the answer might be found in a study of the development of silicon carbide and aluminum oxide crystals in a furnace where operating temperatures exceeded 2000°C. Not only did researchers of The Carborundum Company develop a high-temperature microscope for this work—they hooked it up with a camera to photograph the reaction in color.

These two, out of a hundred and one research activities underway at The Carborundum Company, help explain why the right abrasive products by CARBORUNDUM are ready whenever new high-temperature alloys or other new materials are developed, or new industrial techniques put into operation.

From these laboratories have come wheels that precision grind thousands of parts with unvarying accuracy...belts and discs that cut faster and cooler, grains that generate high finishes in a hurry. It is an extra assurance of continual improvement in grinding, sanding and finishing with abrasives by CARBORUNDUM. The Carborundum Company, Niagara Falls, New York.

The only complete line of Abrasive Tools is

CARBORUNDUM

TRADE MARK

"Carborundum" and "Aloxite" are registered trademarks which indicate manufacture by The Carborundum Company

Engineering News
ON ABRASIVE PRODUCTS

ALOXITE TPT POLISHING GRAIN

TPT is a new aluminum oxide abrasive grain specially developed for polishing operations which require removal of comparatively large amounts of metal. Especially suited for severe polishing operations, it cuts fast and is highly efficient. In actual comparative tests, this tough, sharp, long lasting abrasive gives as much as 100% greater production per wheel set up. It is also ideally suited to the entire field of grain polishing applications and can be applied successfully and economically within its available grit range, sizes 16 to 60.

TPT POLISHING GRAIN OFFERS THESE IMPROVED QUALITIES:

TOUGHNESS—Special processing assures resistance to fracture, on severe operations. Polishing wheels headed with TPT grain last longer and require heading less frequently.

UNIFORMITY—All working grain, solid, well-shaped, sharp and angular—free from useless flats, splinters and weak particles.

FASTER CUTTING—Sharp particles retain sharpness and angularity for longer periods...provide higher production rates and more economical operation.

IMPROVED EFFICIENCY—Each set-up lasts longer, produces more pieces per hour, and cuts abrasive and polishing costs. Longer lasting polishing wheel set-ups reduce number of expensive re-headings.

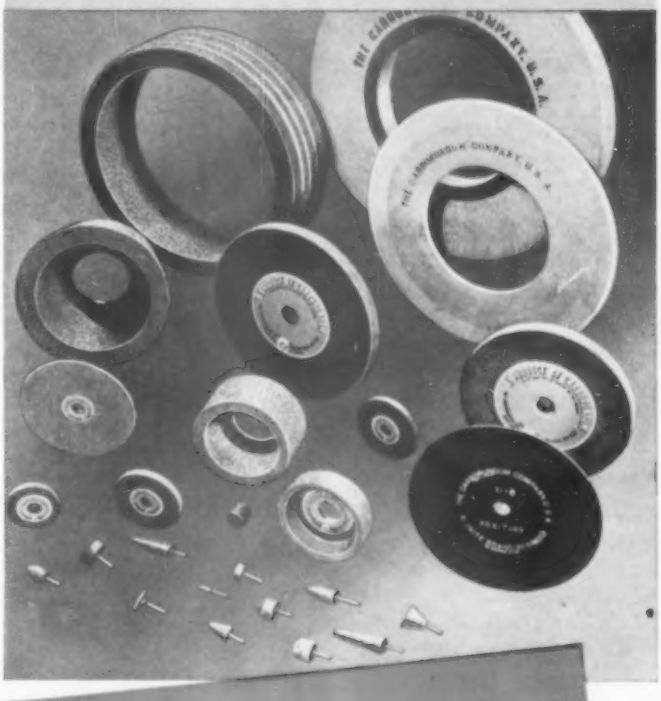
THE VONNEGUT BRUSH-BACKED SANDER HEAD

Designed for use on irregular surfaces, this sander head finishes, in seconds, jobs that usually take minutes longer by costly hand sanding or other less efficient methods. Shredded abrasive tips contact every groove and depression of contours, curves, carved and moulded surfaces... produce an excellent uniform finish which may be buffed easily as desired. It is particularly effective in blending surface irregularities and eliminating scratches, mold flash and burrs of moderate severity.

While the use of the Vonnegut sander head is new to the metal working field, it is not new in principle. For many years, it has been used successfully by the wood-working trade. Practical production experience in metal operations shows equally successful and economical results. The heads are cleaner in service, cooler-cutting, operate with less pressure and enable workers to produce better finishes with less effort. Their design and construction is simple. Loading, adjustment and operation are easy.

COATED PRODUCTS — SHEETS • ROLLS • BELTS • DISCS SPECIAL SHAPES

BONDED PRODUCTS — ABRASIVE WHEELS • STICKS, STONES AND RUBS • SPECIALTIES • SUPERFINISHING STONES • SPECIAL FORMS • ABRASIVE GRAINS AND FINISHING COMPOUNDS

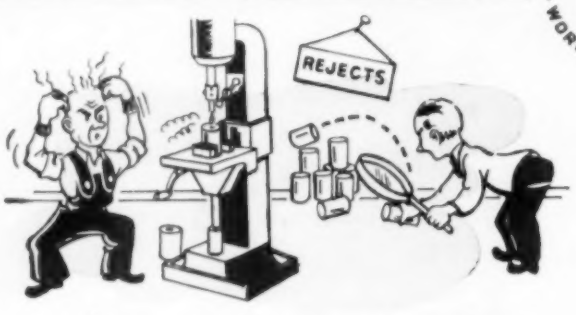


FOR EVERY ABRASIVE APPLICATION
....CALL IN
CARBORUNDUM
TRADE MARK

Here's a method of tapping that is really quite slow.
Just a drop in the bucket . . . and production is low.

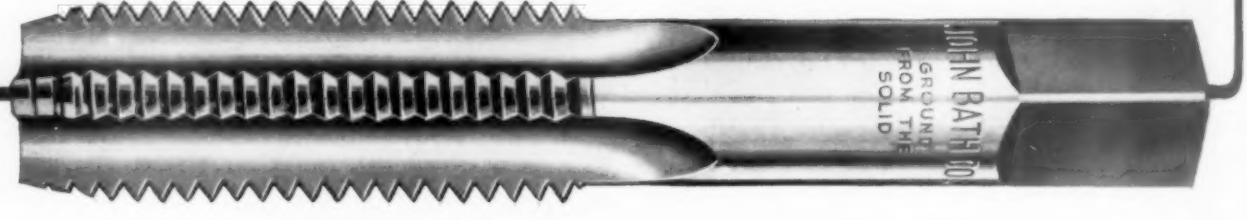
Some day we expect that a very smart geezer,
Will speed up production with a maple tree squeezer!

JOHN BATH CO. INC. · WORCESTER · MASS · B



If you run a tap slow, cutting edges will wear,
And rejected pieces will get in your hair.

Bath Taps are built for high threading speed!
They'll increase production . . . which you surely need!



INSIST ON BATH TAPS . . . PROFIT BY THEIR PLUS-PERFORMANCE

Bath Ground Thread Taps are designed and made for operation at high speeds . . . the best speed depends upon equipment, lubrication and type of work.

It has been found that many jobs can be threaded at a speed of 100 to 150 surface feet per minute, where it was impossible at a lower speed.

High speed not only increases production but gives longer tap life and smoother and more accurate threads.

Stock size and special Bath Taps will give you plus-performance!

PLUG AND RING THREAD GAGES • GROUND THREAD TAPS • INTERNAL MICROMETERS

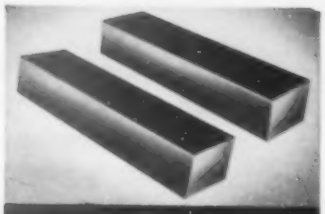
JOHN BATH CO. INCORPORATED

28 Grafton St., Worcester, Mass.

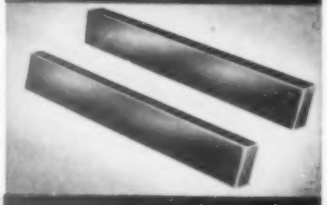
HAYNES STELLITE 98M2 TOOLS

Trade-Mark

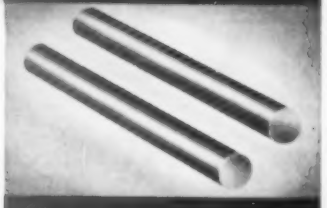
have ... red hardness
... increased edge strength
... toughness



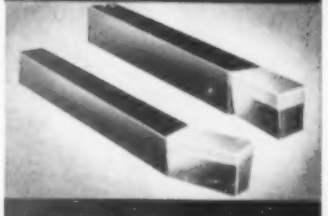
SQUARE TOOL BITS



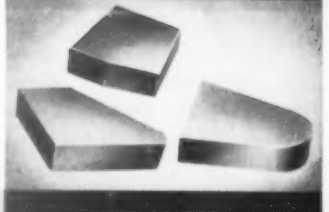
RECTANGULAR TOOL BITS



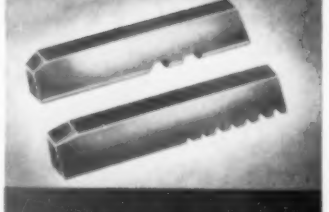
ROUND TOOL BITS



TIPPED TOOLS



TOOL TIPS



INSERT MILLING CUTTER BLADES

HAYNES Stellite 98M2 tools are especially suitable for faster production machining of ferrous and non-ferrous metals, plastics, and wood. In addition to the standard tools illustrated, special tools, made to your specifications can be promptly furnished.

98M2 alloy—composed of cobalt, chromium, and tungsten—is inherently hard. And since its hardness is not the result of heat treatment, tools made of this alloy have no "temper" to be affected by high temperatures. They cut efficiently even at red heat, and have a good balance of hardness, edge-strength and toughness. This unusual combination of properties makes possible heavy cuts and coarse feeds at high speeds. This high rate of stock removal assures a low cost per piece machined.

For a complete list of styles, sizes, and prices of stocked standards, write to the nearest district office for a copy of the booklet, "HAYNES Stellite Metal Cutting Tools" Form 5401.

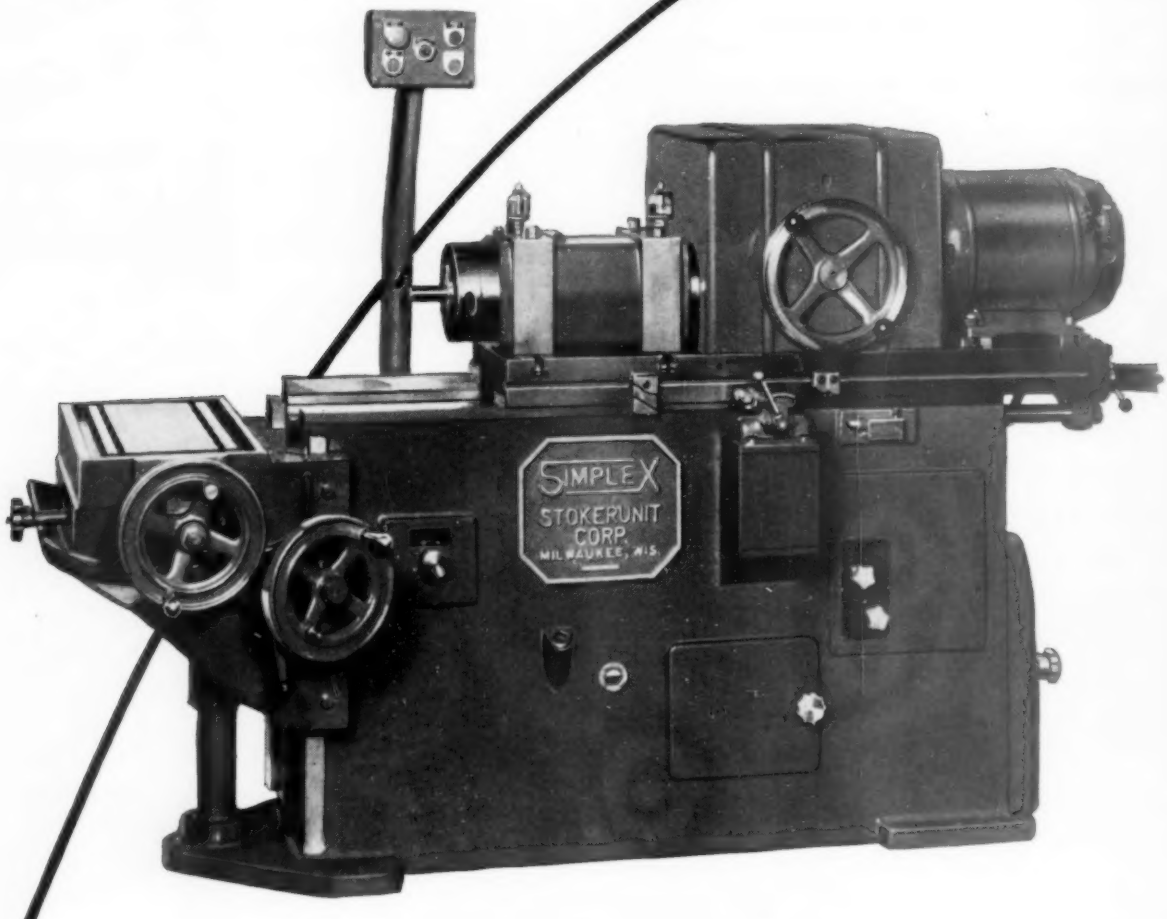
HAYNES TRADE-MARK *alloys*

Haynes Stellite Company
Unit of Union Carbide and Carbon Corporation
UCC
General Offices and Works, Kokomo, Indiana
Sales Offices: Chicago — Cleveland — Detroit — Houston — Los Angeles — New York — San Francisco — Tulsa

The registered trade-marks, "Haynes" and "Haynes Stellite" distinguish products of Haynes Stellite Company.

SIMPLEX

There are times when small production requirements of a wide variety of parts make the selection of a suitable precision boring machine very difficult. The SIMPLEX Knee-Type Precision Boring Machine answers these problems with a highly flexible machine with rapid change-over characteristics.



The SIMPLEX Knee-Type Precision Boring Machine offers a standard precision boring unit with adjustable knee mounted on one end to provide a large range of distance from the spindle center to the top of the table. Table is transversely adjustable on the knee using hardened and ground Vee and flat ways as on the bed and spindle table. The spindle drive is through a variable speed unit controlled by the large hand wheel. A turret stop on the end of the table provides for boring to different depths. With this machine, a few quills and simple fixtures, a wide range of precision boring operations becomes practical and economical.

PRECISION BORING MACHINES

SIMPLEX MACHINE TOOLS DIVISION

STOKERUNIT CORPORATION

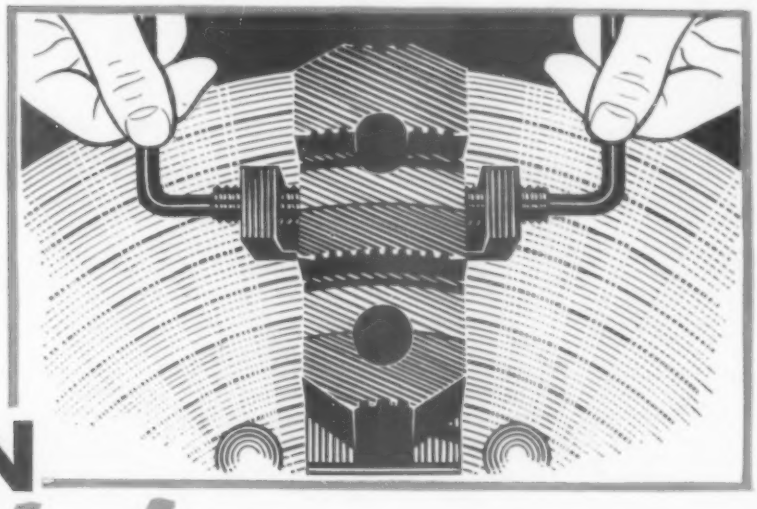
4528 West Mitchell Street

MILWAUKEE, WISCONSIN

Precision Boring Machines, Planer Type Milling Machines, Special Machine Tools

Individual Jaw Adjustment

to within .001 Concentricity



CUSHMAN *Accralock* CHUCKS

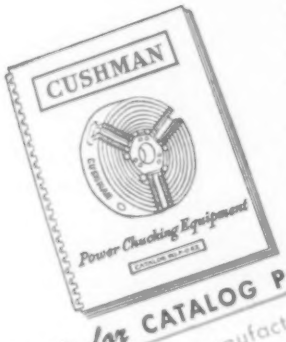
The Cushman Power Chuck has been designed to obtain the full out-put potentials of modern machine tools in repetitive production by speeding the grip and release of work holding jaws . . . reducing operator fatigue to a minimum.

In addition, the "Accralock", Cushman's exclusive device for quick and extremely accurate individual jaw adjustment assures concentricity to within .001" for safe holding of irregular work under heavy loads and feeds.

Cushman Power Chuck installations are simple, and applicable to all types of single and multiple spindle automatics, horizontal turrets and chucking machines, grinders, etc.

To answer questions on selection and application, Cushman Engineers are always ready to serve you.

THE CUSHMAN CHUCK COMPANY
Hartford 2, Connecticut



Write for CATALOG PO63

CUSHMAN also manufactures a complete series of BENCH OPERATED CHUCKS
Write for Catalog 63 and Bulletins

Consult
CUSHMAN
Chucking Engineers Since 1862

Does This

Steadying Hand

WORK IN *Your* **SHOP ?**

Utility Tools

TAKE THE *WOBBLE* OUT OF WORN SPINDLES WITH *GLENCO*

Floating Holders

Their actual compensating movement under load positively CORRECTS MIS-ALIGNMENT. Accurate holes can still be machined with correction up to 1/32" radius—no more lopsided, out-of-true or bell-mouth holes even with old machines, when you use GLENCO.

Use them on hand and automatic screw machines, Garvin Tapping Machines, Adjustable Multiple Spindles, Tapping Machines of all types, Drilling Machines of all kinds.

26 TYPES

Send for Index J Data Sheets.

Test any stock size 30 days without obligation.

THE J. C. *GLENZER* CO., Inc.
1552 E. NINE MILE ROAD, DETROIT 20, MICH.

UNBRAKO

KNURLED SOCKET HEAD CAP SCREWS

Knurling of Socket Screws originated with "Unbrako" in 1934.

...Slip-Proof

The most widely used socket head cap screw in toolrooms, die shops, assembly departments and maintenance work is "UNBRAKO" with its *Knurled* head. Because the knurls prevent slippage and "finger fumbling"—be the heads ever so oily—and thus speed assembly, tool-makers, die-workers and production workers naturally prefer "UNBRAKO" Knurled Socket Head Cap Screws.

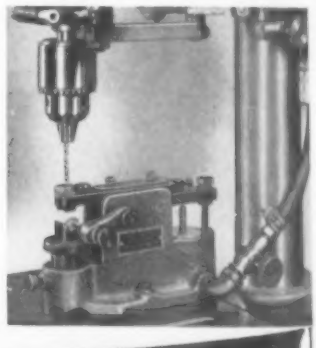
Write us for the name and address of your nearest "Unbrako" Industrial Distributor and for your copy of the "Unbrako" catalog.

OVER 46 YEARS IN BUSINESS

SPS STANDARD PRESSED STEEL CO.
BOX 780 JENKINTOWN, PENNSYLVANIA

"Serving Industry continuously since 1903 through Industrial Distributors"

Here's a Lead Worth Checking



Por-Matic AIR-OPERATED UNIVERSAL *Drilling* FIXTURE...

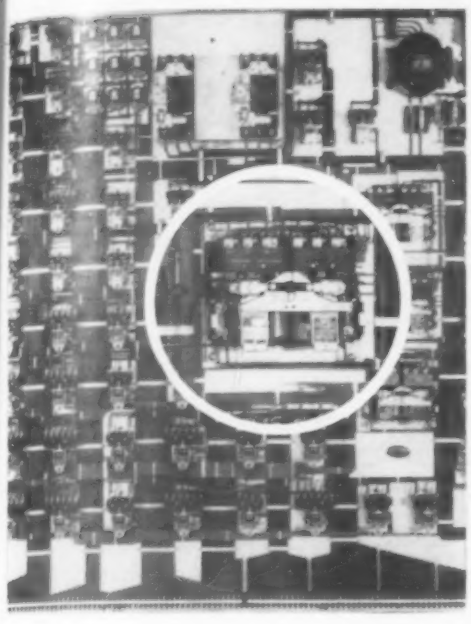
Faster... Easier Set-Up... with LESS COST... that's the story of hole drilling with the Por-Matic Drilling Fixture. Production increases of 33% to 200%... and Por-Matic handles ferrous or non-ferrous rounds from 1/16" to 1"... extra units are available for drilling special shapes.

Por-Matic can be mounted singly or in groups on any regular bench or floor type drill press. Better check this lead NOW... it pays off in PROFITS!

•

THE PORTER MACHINE CO.
3100 ENYART AVENUE... CINCINNATI 9, OHIO

SNYDER *Machines Cost Less in the Long Run*

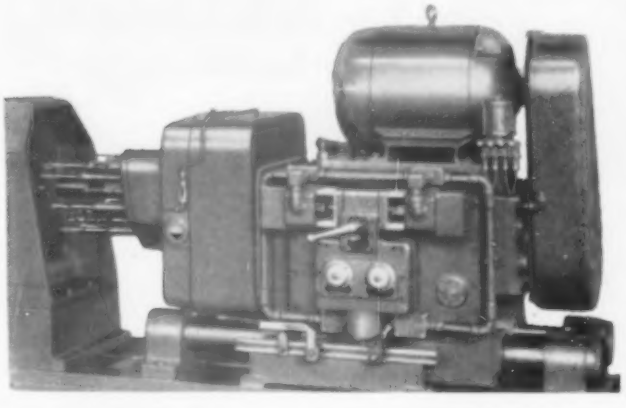


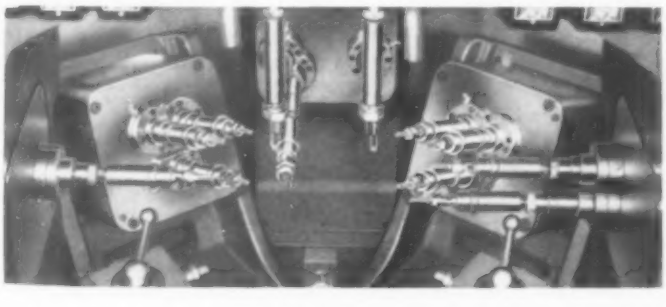
BEAUTY BY THE MILE

Maybe it isn't important that a control panel be beautiful except that in the case of Snyder panels the beauty is the result of the perfect orderliness of the layout. Every circuit can be traced, clearly and easily. Every cycle is protected, when desirable, by interlocks to prevent machine damage through electrical failure. Every panel is provided with manual operation for tool set-up. All conform to established standards. Miles of wire are set into the panels yearly, every inch with such precision and neatness that our panels are notably compact. Building these beautiful panels in our own shop makes us independent of outside delivery dates, gives us close coordination during building and testing each machine and enables us to deliver a better job that saves you money in the long run.

QUICK-CHANGE ARTIST

We think we've done an exceptional job on our standardized component units, used on most of our machines. All units, whether way or guide bar type, have hardened and ground bearing surfaces. They provide any required stroke up to 24", yet, create no problem of overhang on extended stroke, as do ram-type units. They are so adaptable and so well built that they can be re-tooled over and over again thereby delivering substantial savings in machine investment since retooling can give you an entirely different operation at minimum cost. Special units are designed with the same objective—to give you durability and versatility that will save you money in the long run.





YOUR TAPS ARE TOPS IN SNYDER SPINDLES

A good many years ago we satisfied ourselves that the individual lead screw type of tapping head is the most effective means of leading taps into the work and established it as our standard equipment. This method permits proper speed selection for each individual tap; produces a more accurate thread; eliminates the hazard of thread-stripping. Threads of the lead screw are precision ground after hardening. Snyder safety tap drivers are used exclusively to eliminate tap breakage. Lead screw tapping nuts are of the finest bronze and are replaceable. These features have satisfied the precision requirements of ordnance and aircraft work. They will satisfy you and save you money in the long run.

SNYDER

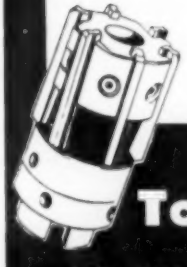
TOOL AND ENGINEERING COMPANY

3400 E. LAFAYETTE
DETROIT 7, MICHIGAN

24 Years of Successful Cooperation with Leading American Industries

Ever use a really free cutting reamer?

TRY WAUKESHA'S SHELL OR SHANK TYPE *with* "CUSHION - LOCKED" ADJUSTABLE BLADES



For standard and heavy-duty work
Sizes up to 6¼" in stock
Larger sizes on application

WAUKESHA Tool Corporation

1424 Arcadian Avenue — WAUKESHA, WISCONSIN

DIAMOND
Multi-Max Punch Press

CAPACITY 30 TONS

- DOUBLE CRANK
- SINGLE GEARED

EXCEPTIONALLY LARGE BED & RAM AREAS

Write FOR COMPLETE CATALOG

DIAMOND MACHINE TOOL COMPANY
3427 EAST OLYMPIC BLVD., LOS ANGELES 23, CALIF.
OFFICE AND WAREHOUSE IN CHICAGO

TRY THIS *simpler way* OF ALIGNING THE WORK WITH THE SPINDLE!

On tapping and reaming jobs, instead of spending the extra time necessary to make an absolutely accurate alignment of the work with the spindle, why not try this simpler way!

In place of an ordinary tool holder, use a Ziegler Tool Holder. Then all you have to do is align the work with spindle to within 1/32" radius or 1/16" diameter, and the Ziegler Holder automatically compensates for the difference.

You'll find that the labor costs saved will reimburse you for the cost of the Ziegler Holder in a remarkably short time and then continue to save you money throughout the life of the holder. Try it and see.

Made to Fit Any Machine

Furnished with male or female taper, straight, threaded or special shanks to fit any machine used for tapping or reaming.

WRITE FOR CATALOG

W. M. Ziegler Tool Co.
13570 Auburn
Detroit 23, Mich.

Ziegler ROLLER DRIVE **FLOATING HOLDER** *for* **Taps** *and* **Reamers...**

You will be amazed at the performance of the REDESIGNED *Cleveland* END MILLS

STRONGER! CUT FASTER! CLEAR CHIPS BETTER!

Much Greater Durability and Accuracy!

The new *Cleveland* End Mills are far superior to any you have ever used! They have been completely redesigned to give you strength, speed and accuracy that were never before obtainable! Many months ago we set out to design a different and better end mill. Neither time nor effort was spared in patient development work. We even worked out a new technique for testing the cutting qualities and the stamina of end mills. Users are enthusiastic about the results: Less breakage, many more cuts per grind, consistent accuracy . . . with up to *50% increase in feed.* For high speed, low cost operation, use the new *Cleveland* End Mills on your next job. Contact our Stockroom nearest you, or . . .

Telephone your Industrial Supply Distributor

STRONGER
No sharp corners or points where localization of stresses might occur. Minimum amount of metal has been cut away.

MORE DURABLE
New-style clearance supports the cutting edge; assures against "flaking" or "chipping out."

LONGER LIFE
Radically new flute shape and chip clearing ability reduce wear on the cutting edge, thus maintaining consistent accuracy.

CUT FASTER
New flute shape gives maximum cutting qualities at increased rates of feed.

CLEAR CHIPS BETTER
Redesigned flutes are machine polished. There are no pockets. Chips are free to move.

GREATER ACCURACY
New clearance and accurate machine polish of flutes result in closer control of size.

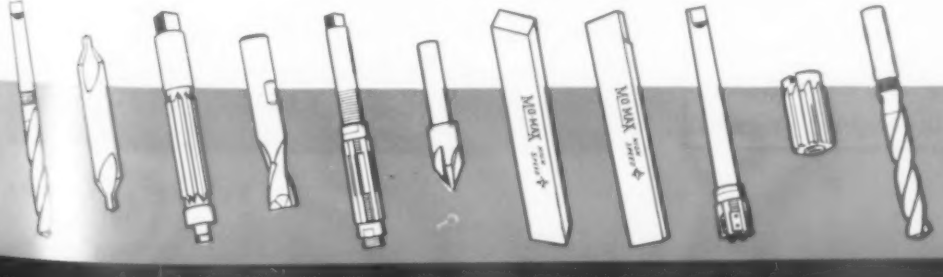
THE CLEVELAND TWIST DRILL CO.

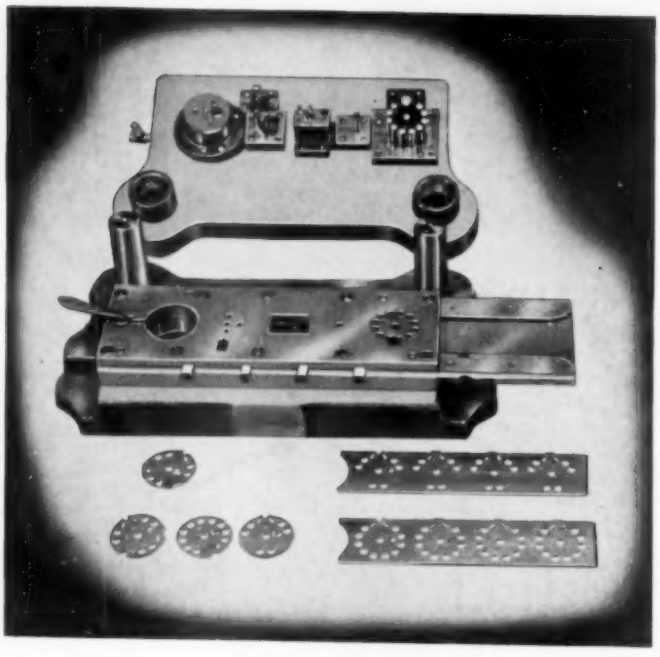
1242 East 49th Street • Cleveland 14, Ohio

Stockrooms: New York 7 • Detroit 2 • Chicago 6 • Dallas 1 • San Francisco 5 • Los Angeles 11

E. P. Barrus, Ltd., London W. 3, England

ASK YOUR INDUSTRIAL SUPPLY DISTRIBUTOR FOR THESE AND OTHER *Cleveland* TOOLS





WE'LL "DIE" FOR YOU!

Just one of many Nueske precision tools which have helped to solve industry's production problems.

Serving the best firms with the best in Tools, Dies, Gages, Jigs, Fixtures, and Special Machines and Machine Work.

Write for Free Brochure

"Forty Years without Peers"

DESIGNERS & BUILDERS OF TOOLS, DIES, JIGS, FIXTURES

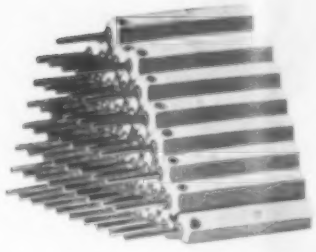
NT&M CORP

NUESKE TOOL AND MACHINE CORP.

45-16 COURT SQUARE
LONG ISLAND CITY 1, NEW YORK

Van Keuren

CARBOLOY WIRE TYPE PLUG GAGES



One VAN KEUREN CARBOLOY GAGE = **Fifty** TOOL STEEL GAGES

Use VK Carboloy Gages for long run jobs because of the enormous saving in gage cost.

Use VK Carboloy Gages on fussy jobs because of the infinitesimal gage wear. All parts will be within the specified limits.

VK Carboloy wire type plug gages are made to Class B accuracy, plus .00005" minus .00000" on the Go unit and plus or minus .000025" on the No Go unit. Closer or wider tolerances can be supplied if desired.

Catalog and Handbook No. 34

This 208 page volume represents 2 years of research sponsored by the Van Keuren Co. It presents for the first time in history a simple and exact method of measuring screws and worms with wires. It tells how to measure gears, splines and involute serrations. It is an accepted reference book for measuring problems and methods. Copies free upon request

THE Van Keuren CO., 174 Waltham St., Watertown, Mass.

30th YEAR

Light Wave Equipment • Light Wave Micrometers • Gage Blocks • Taper Insert Plug Gages • Wire Type Plug Gages • Measuring Wires • Thread Measuring Wires • Gear Measuring System • Shop Triangles • Carboloy Measuring Wires • Carboloy Plug Gages

---

Columbia TOOL STEEL

OUR GOAL—

The goal of the Columbia Tool Steel Company is to be a good firm to

Work for
Sell to
Buy from

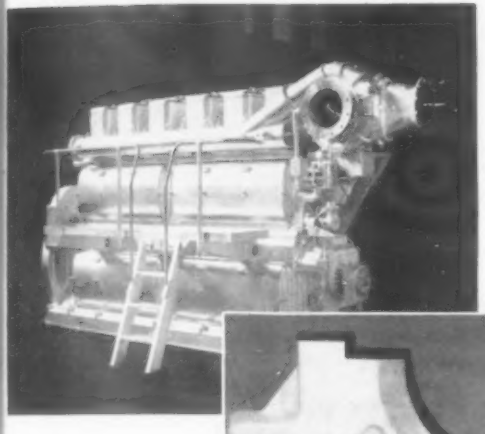
COLUMBIA TOOL STEEL COMPANY

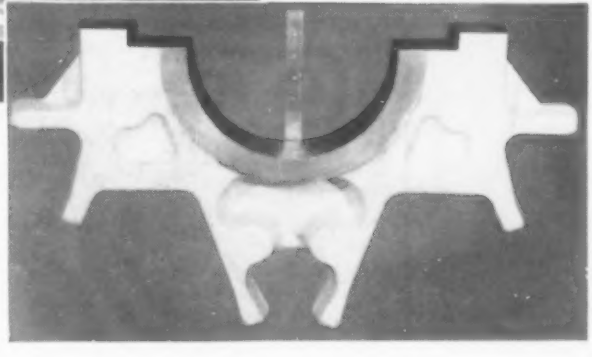
ARTHUR T. CLARAGE, PRESIDENT
MAIN OFFICE AND WORKS
520 EAST 14TH. STREET • CHICAGO HEIGHTS, ILL.

20 TIMES the PRODUCTION *by Broaching*

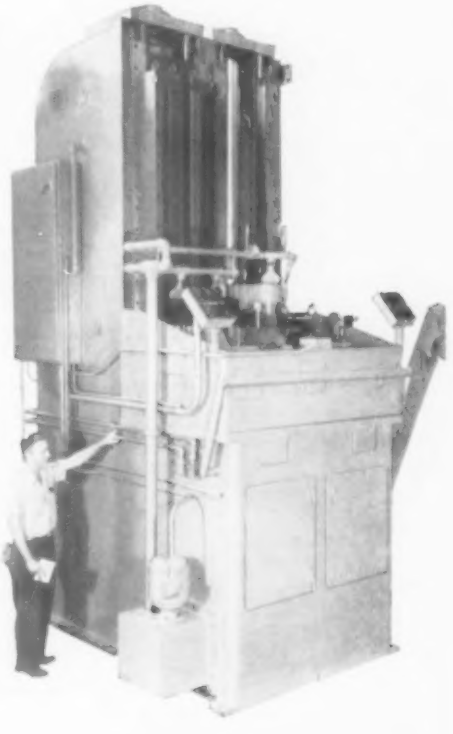
DIESEL BEARING SUPPORTS

American provided the manufacturer of diesel engines with an SBD 72″-40 duplex surface broaching machine to finish broach the stepped joint faces and rough broach the 8″ diameter half round on main bearing saddle forgings.





One half inch of stock is removed in broaching the stepped joint face and half round.



Approximately sixty cubic inches of surface on this 150 pound diesel engine main bearing saddle forging is removed in broaching by the adaptation of an automatic indexing table and broach arbor arrangement.

The left hand station broaches the step joint faces in six passes and the right hand station rough broaches the half round surface in six passes. The left hand table automatically indexes at each pass and the arbor on the right hand ram also automatically indexes at each pass to develop the radius form with four sectional broach assemblies. One part is completed at end of the six continuous passes.

American engineers will recommend the machine and tooling whenever broaching is the answer to your machining problem. Send part print and production requirement or write for the name of our dealer in your territory. They will be pleased to call.

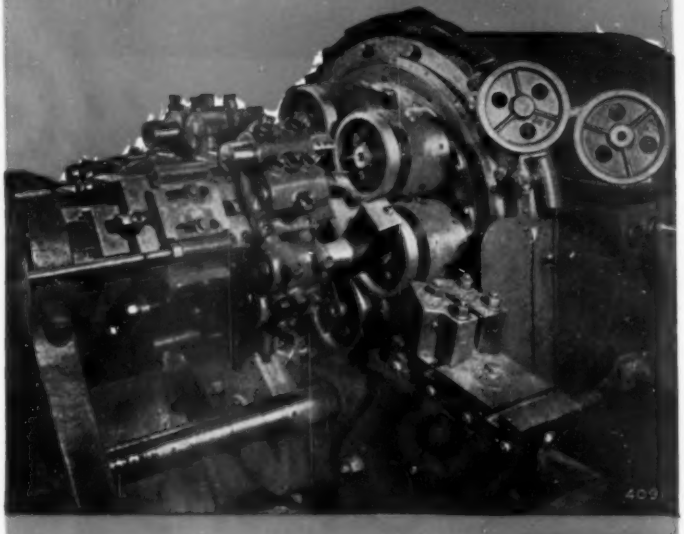
American BROACH & MACHINE CO.

A DIVISION OF SUNDSTRAND MACHINE TOOL CO.

ANN ARBOR, MICHIGAN

See *American* First — for the Best in Broaching Tools, Broaching Machines, Special Machinery

fact: gear blanks are turned with accuracy and speed on Baird Automatic Chucking Machines!



You need a Baird Automatic Chucking Machine in your shop if you have turning operations that must be done profitably. *That's been a fact since the turn of the century!*

You need a Baird because it is the one machine that you can depend upon, friend of the tool engineer and shop superintendent alike because of its speed and accuracy.

The machine illustrated above shows why! Here facing, turning and boring gear blanks is combined in one operation. The tolerances were close, the stock was hard but Baird maintained accuracy and set new production per hour records.

Here the special Baird feature of selection of spindle speed for each position proved its value: high spindle speeds were selected in the finishing positions so that carbide tools could be used to produce the fine accurate surfaces demanded.

When you have turning operations that must be done profitably:
ASK BAIRD ABOUT IT

Write us for complete specifications of the many Baird Automatic Chucking Machines.

THE BAIRD MACHINE COMPANY, STRATFORD, CONN.

YOUR "SPECIAL BUSHINGS" MAY BE OUR REGULAR STOCK ITEMS!

Ready for Immediate Delivery

TWO complete bushing standards, the A.S.A. Standard plus our own Acme Standard, provides a much wider selection, enabling you to obtain bushings from stock that often would require special manufacture. Results in faster delivery, lower cost. Write for catalog.

Accurate Interchangeable Concentric

Acme Industrial Company

Makers of Hardened and Ground Precision Parts

200 N. Laflin Street • Chicago 7, Illinois

THE SERVICE SHOP TO INDUSTRY FOR MORE THAN 25 YEARS

THE NEW SAFETY "UTILITY" MARKING OUTFIT

Holder Holds Nine Sizes of Type From 1/32" to 1/4"

Designed for light stamping work, the "Utility" outfit is ideal for marking etched plates, tags, keys, stock checks; brand names or stock numbers on steel bars; special coding, serial numbering, identification, inspection and other marking where two or more characters are required.

Send for Literature and Prices

M.E. CUNNINGHAM CO.
SAFETY STEEL STAMPS

169 E. CARSON STREET PITTSBURGH, PA.

You Cut Production Costs .... if You use ....

STRENGTH · TOUGHNESS · UNIFORMITY · ENDURANCE

SIFCOLOY

CONTROLLED METAL CASTINGS

WHAT SIFCOLOY IS . . .

SIFCOLOY Metal is a development in the manufacture of cast iron that involves a special technique in charging, melting, and control of the molten iron before pouring. Therefore, the intrinsic nature of SIFCOLOY Metal is controlled to meet the type of service for which the specific castings are to be used. For this reason, SIFCOLOY Metal is made in 5 basic grades each varying in physical properties.

WHY SIFCOLOY CASTINGS ARE BETTER

1. SIFCOLOY has greater tensile and compressive strength than ordinary grey iron and is *heat treatable*. (Grades SI and SIA)
2. SIFCOLOY, though much closer grain, is readily *machinable*.
3. SIFCOLOY is adaptable to a wide variety of dies, plates, and cast machinery parts. (See photos below)
4. SIFCOLOY is made in 5 basic grades to fit your individual needs.
5. SIFCOLOY affords longer life . . . due to its greater wear resistance, hence cuts your production costs.

Showing varied use of SIFCOLOY Dies for Stamping, Drawing Plain Carbon and Stainless Steel Sheets and Compression Molding of Plastics

REFRIGERATOR PAN

BED PAN

GARBAGE CAN

WATER PAIL

BEER BARREL

"Sifcoloy Metal for Better Castings and Better Costs!"

WRITE FOR COMPLETE INFORMATION

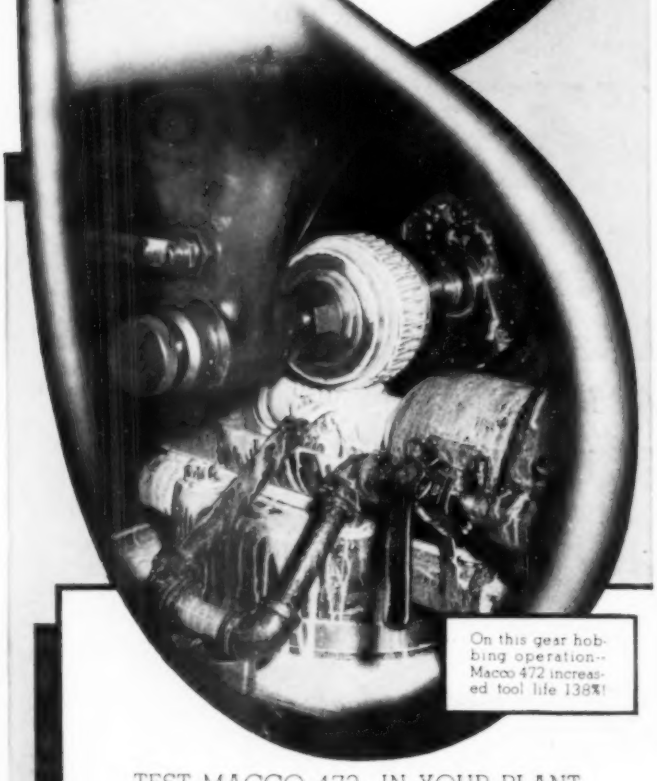
SPUCK IRON and FOUNDRY CO.

3145 N. FOURTEENTH ST. • • • ST. LOUIS 7, MO.

CUT PRODUCTION COSTS with

MACCO 472

The Cutting Lubricant that reduces costs & increases profit



On this gear hobbing operation--Macco 472 increased tool life 138%!

TEST MACCO 472--IN YOUR PLANT

There are dozens of cutting lubricants of various types on the market today. And, perhaps you've already tried a number of them in your plant -- with indifferent results.

But until you actually test Macco 472 -- it will be hard to believe that one lubricant can possibly be so vastly superior to others. However, Macco 472 IS superior -- that's why it's so widely used in so many leading plants.

A test will give you convincing proof that Macco 472 will cut your costs and increase your profits--regardless of the machines you have...the tools you use... or...the metal you process.

If you will make the test, we will gladly supply the Macco 472--no charge or obligation. How about it?

Send for this new illustrated folder filled with facts on Macco 472.

MACCO PRODUCTS COMPANY

525 WEST 76TH STREET • CHICAGO, 20, ILLINOIS

DRILL HARDENED STEEL WITH "HI-ROCKWELL" DRILLS WITHOUT ANNEALING

Every toolroom needs Ray-Metal "Hi-Rockwell" drills. These tools drill precision holes in steels testing C-40 to C-68 Rockwell quickly and without annealing. Ideal for reworking tools and dies, they actually cut a curled chip! *THEY CUT!!!*

Sales territories open.

Available in standard sizes—order from:

RAY-METAL
RIGID-CARBIDE-TOOLS

9500 Carbon Street — Detroit 17, Michigan

LESS OPERATIONS AND BETTER WORK

WITH A GATCO ROTARY PILOT BUSHING

DUST PROOF

AS A WATCH

ROUND-CHATTERLESS-SMOOTH

GATCO Rotary jig and pilot bushing is built for core drilling, diamond boring, turret tool piloting, piloting hollow mills, line reaming, carbide boring, spot facing, etc.

Originators of Rotary Jig & Pilot Bushings

GATCO ROTARY BUSHING CO.

1300 Mt. Elliott Avenue • Detroit 7, Michigan

GAMMONS REAMERS★

Originators and Manufacturers of Helical Reamers and End Mills

Helical Taper Pin Reamers Shipped by Return Mail

The

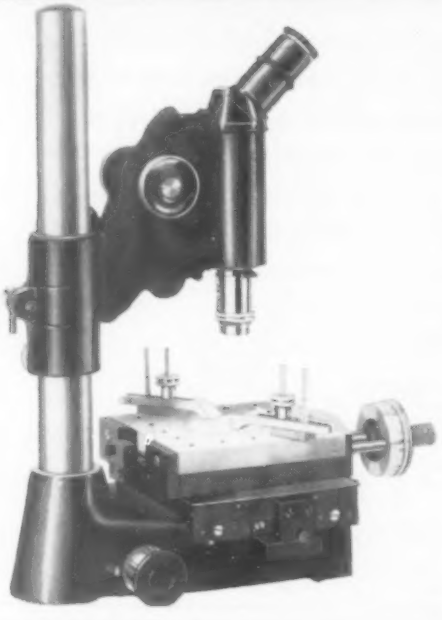
GAMMONS-HOAGLUND

Company

400 Main Street, Manchester, Conn.

LOWER COSTS OF PRODUCTION OF INSPECTION

WITH THESE
BAUSCH & LOMB PRECISION INSTRUMENTS



TOOLMAKERS' MICROSCOPE

A sturdy shop instrument especially designed for the machinist and toolmaker. It is used for precision linear measurements and, when fitted with the protractor eyepiece, for precision angular measurements. Objects and movements are seen in their natural aspect and direction . . . not reversed as in ordinary microscopes. Both opaque and transparent objects of regular or irregular contour can be measured. It is ideal for measuring parts which would distort under pressure of the most delicate instruments.

Operation is exceptionally simple and fast. Linear measurements to ±.0001" can be made by means of the cross slide stage, controlled by two micrometer screws, and angular measurements to ±1 minute of arc (1'). Various other attachments are available to meet special measurement problems. Catalog D-22.

New PARA-PLANE GAGES

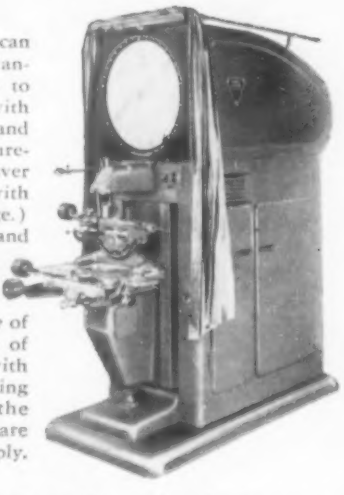
Now you can have "laboratory" accuracy of 0.000001" in the determination of flatness and parallelism of reflecting surfaces . . . with production-line *simplicity* and *speed*. So simple that an unskilled operator can make measurements after a few minutes of instruction.

Two sizes of Para-Plane Gages are available. *Bulletin* D-224.

New STEREOSCOPIC WIDE FIELD MICROSCOPES

Provide clear, sharp, three-dimentional, unreversed, magnified images. Used extensively in industry for greater speed and accuracy in small parts assembly operations, inspection of tools and finished parts, and precision curacy in small parts assembly different models for many uses. *Catalog. D*-15.

CONTOUR MEASURING PROJECTOR



No other projector can match its accuracy (angular measurements to ± 1 minute of arc with a protractor screen, and direct linear measurements to ±.0001" over a range of 4"x6" with the cross slide stage.) Dimensions, angles, and profiles of production-run parts can be compared directly with a *traced outline* of the projected image of the master part, or with a large scale drawing superimposed on the screen. Inaccuracies are found quickly...simply.

WRITE for complete information on these five important optical aids designed to help you save time and money. You may be paying many times over their cost in lost time and rejects. Send your request to Bausch & Lomb Optical Company, 763-H St. Paul Street, Rochester 2, New York.

BAUSCH & LOMB
OPTICAL COMPANY B&L ROCHESTER 2, N.Y.

Cutting tools by Gorham are

just that!

Whatever your needs in special high speed steel and carbide tipped cutting tools—you can be sure of one thing: The name GORHAM means top performance and lasting quality . . . the most for your money in any tool you buy. Long experience in the selection and heat treating of metals has put GORHAM in the front rank of America's leading tool makers. You can depend on GORHAM to deliver *special* service . . . you can count on GORHAM for *special* results! Specify GORHAM for all your cutting tool needs.

GORHAM TOOL COMPANY

14400 WOODROW WILSON · DETROIT 3, MICH.

A FIXTURE LOCK TO SUIT ANY REQUIREMENT

AVOID SLOW OPERATING CLAMPS

Both Single and Double Action Locks are used in this Tooling.

The Single Action Lock Clamps the part, while the Lower or Double Action Lock securely holds the Movable Carriage in the desired position against stops.

SWARTZ TOOL PRODUCTS CO., INC.

13330 Foley Ave. ASK FOR CATALOG 941 Detroit 27, Michigan

YOUR DANLY DIE SET IS ONLY HOURS AWAY!

8 assembly branches in key locations stock all standard Danly Die Set components for *immediate* assembly and delivery!

Just select the standard Danly Set that meets your requirements...from the thousands of interchangeable combinations listed in the Danly catalog ...and phone, wire or write your nearest Danly branch. Prompt, efficient delivery will eliminate costly delay.

And Danly Precision Die Sets will make your dies last longer, too! Ground and lapped leader pins and bushings assure accurate die relationship.

For faster service and longer die life, always specify a Danly Die Set.

Write for this Free Bulletin

...and see how Danly's special die set machining service will mean important savings in your tool shop

Which DANLY branch is closest to you?

*Chicago 50, 2100 South 52nd Avenue
*Cleveland 14, 1550 East 33rd Street
*Dayton 2, 990 East Monument Avenue
*Detroit 16, 1549 Temple Avenue
*Grand Rapids, 113 Michigan Street, N.W.
*Long Island City 1, 47-28 37th Street
*Los Angeles 54, Ducommun Metals & Supply Co., 4890 South Alameda
Milwaukee 2, 111 East Wisconsin Avenue
Philadelphia 44, 18 West Chelten Avenue
*Rochester 4, 16 Commercial Street

* *indicates complete stock*

DANLY

PRECISION DIE SETS...standard and special

Danly Machine Specialties, Inc.
2100 SOUTH 52nd AVENUE, CHICAGO 50, ILLINOIS

OVER 25 YEARS OF DEPENDABLE SERVICE TO THE STAMPING INDUSTRY

Index of Tool Engineer Advertisers

AUGUST, 1949

A

Accurate Bushing Co. 67
Acme Industrial Co. 104
Allegheny-Ludlum Steel Corp. 84
American Broach & Machine Co. 103
Armstrong-Blum Mfg. Co. 73

B

Baird Machine Co. 104
Barber-Colman Co. 16
John Bath Co. Inc. 94
Bausch & Lomb Optical Co. 107
Bay State Abrasive Products Co. 6
Chas. H. Besley & Co. 85
Bethlehem Steel Co. ..... Inside Back Cover
Brown & Sharpe Mfg. Co. 83

C

The Carborundum Co. 92-93
Cleveland Twist Drill Co. 101
Columbia Tool Steel Co. 102
M. E. Cunningham Co. 104
Cushman Chuck Co. 97

D

Danly Machine Specialties, Inc. 109
Detroit Reamer & Tool Co. 82
Diamond Machine Tool Co. 100
The Dykem Co. 110

E

Ex-Cell-O Corp. 111

F

Fellows Gear Shaper Co. 110
Fuller Tool Co. 82

G

Gammons-Hoaglund Co. 106
Gatco Rotary Bushing Co. 106
J. C. Glenzer Co. 98
Gorham Tool Co. 108

H

Hannifin Corp. 8
Hardinge Brothers, Inc. 3
Hartford Special Machinery Co. 81
Haynes Stellite Co. (Unit of Union Carbide & Carbon Corp.) 95
Heald Machine Co. 80
Herman Stone Co. 110

I

Illinois Tool Works 79

K

Kennametal, Inc. 2

L

The R. K. LeBlond Machine Tool Co. 12

M

Macco Products Co. 106
Majestic Tool & Mfg. Co. 89
Millers Falls Co. 7
A. Milne Co. 66

N

National Broach & Machine Co. 112
National Twist Drill & Tool Co. 4-5
Niagara Machine & Tool Works 10-11-15
Norton Co. 14
Nueske Tool & Machine Corp. 102

O

Ohio Knife Co. 65

P

Porter Machine Co. 98
Potter & Johnston Subsidiary of Pratt & Whitney Division of Niles-Bement-Pond Co. 77
Pratt & Whitney, Division Niles-Bement-Pond Co. ..... Inside Front Cover

R

Ray-Metal Co. Inc. 106
Rockwell Mfg. Co. 69

S

Geo. Scherr Co. Inc. 110
Geo. T. Schmidt, Inc. 78
Scully-Jones and Co. 12
Seneca Falls Machine Co. 88
The Sheffield Corp. ..... Back Cover
Snyder Tool & Engineering Co. 99
Spuck Iron & Foundry Co. 105
Standard Pressed Steel Co. 98
The L. S. Starrett Co. 9
Stokerunit Corp. 96
Strong, Carlisle & Hammond Co. 82
D. A. Stuart Oil Co. Ltd. 71
Swartz Tool Products Co. Inc. 108

T

The Taft-Peirce Mfg. Co. 90

U

Universal Engineering Co. 91

V

The Van Keuren Co. 102
Vickers, Inc. 86

W

Wales-Strippit Corp. 87
Waukesha Tool Corp. 100
Winter Bros. 4-5

Z

W. M. Ziegler Tool Co. 100

Fellows

MACHINES and TOOLS

FOR CUTTING
. . . SHAVING
. . . BURNISHING
AND INSPECTION

in GEAR PRODUCTION

FELLOWS

THE FELLOWS GEAR SHAPER COMPANY, SPRINGFIELD, VERMONT

For Low-Cost Precision Measuring—

GRANITE SURFACE PLATES

Produced by Nature — Perfected by Herman Stone

Durable • Accurate • Economical

The inherent hardness and durability of granite, accurately finished to a guaranteed tolerance of .00005", provide the most efficient and economical surface plates for precision measurement operations. Sizes up to 8' x 16'.

★ *Non-Magnetic* ★ *Can Not Warp* ★ *Corrosion-proof*

Write for Free Trial Offer

THE HERMAN STONE COMPANY

324 Harries Bldg. • Dayton 2, Ohio

SCHERR *aids to precision*

OPTICAL COMPARATORS
TOOLMAKER MICROSCOPES
BINOCULAR MICROSCOPES
COMPARATOR GAGES
GEAR TESTERS
HEIGHT GAGES
ILLUMINATED MAGNIFIERS
GAGE BLOCKS
VERNIER CALIPERS
MICROMETERS
TACHOMETERS
SNAP GAGES
"MAGNE-BLOX"
for magnetic-chucks

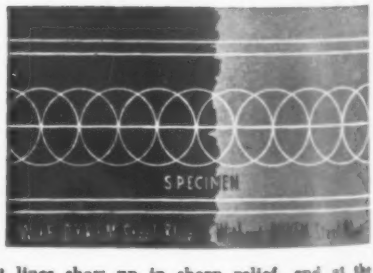
BULLETINS ON REQUEST

GEO. SCHERR CO., Inc. 199-A LAFAYETTE STREET NEW YORK 12, N. Y.

DYKEM STEEL BLUE

STOPS LOSSES

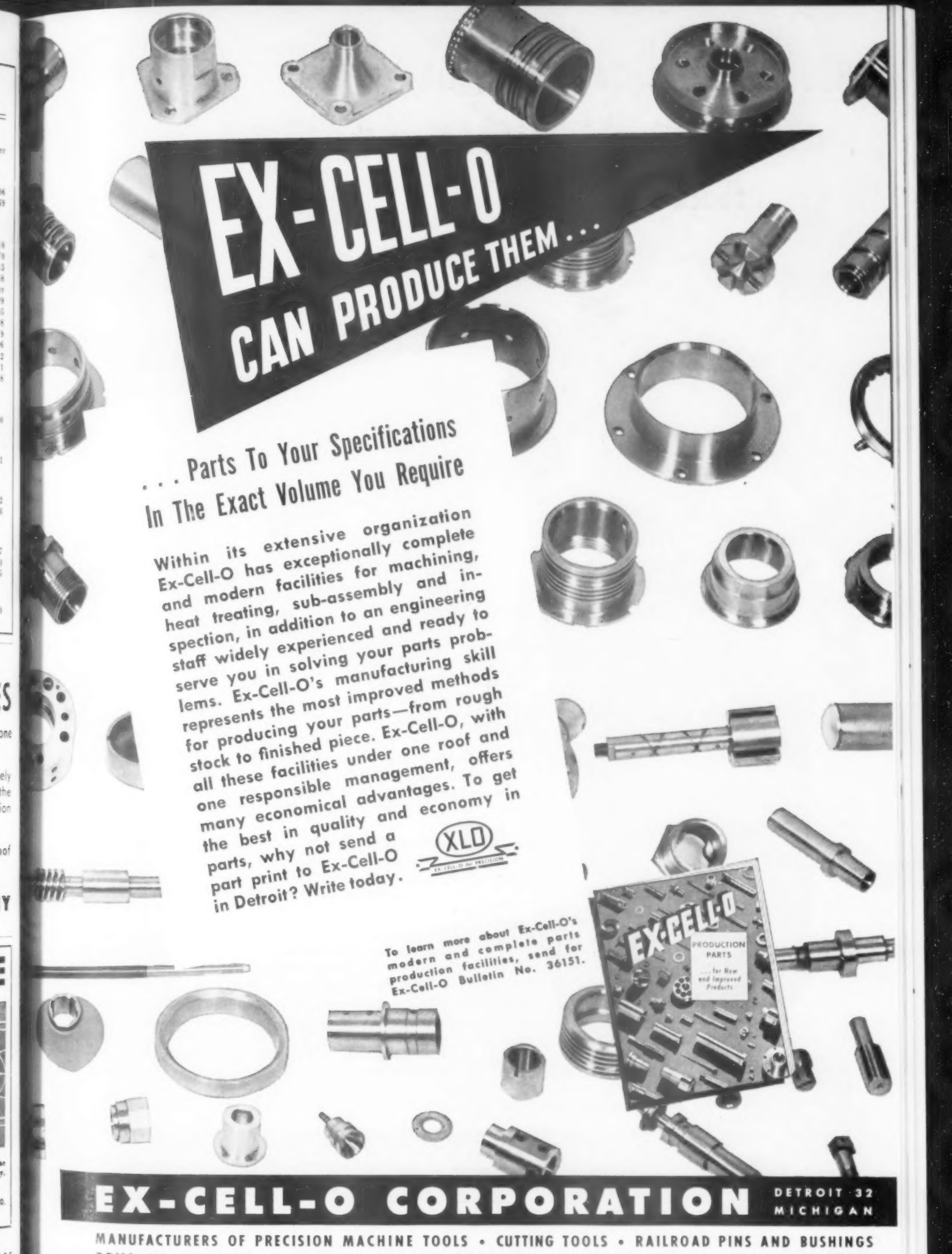
making dies & templates



Simply brush on right at the bench; ready for the layout in a few minutes. The dark blue background makes the scribed layout lines show up in sharp relief, and at the same time prevents metal glare. Increases efficiency and accuracy.

Write for full information

THE DYKEM COMPANY, 2303D North 11th St., St. Louis 6, Mo.
In Canada: 2466 Dundas St. West, Toronto, Ont.


EX-CELL-O
CAN PRODUCE THEM . . .
. . . Parts To Your Specifications
In The Exact Volume You Require
Within its extensive organization Ex-Cell-O has exceptionally complete and modern facilities for machining, heat treating, sub-assembly and inspection, in addition to an engineering staff widely experienced and ready to serve you in solving your parts problems. Ex-Cell-O's manufacturing skill represents the most improved methods for producing your parts—from rough stock to finished piece. Ex-Cell-O, with all these facilities under one roof and one responsible management, offers many economical advantages. To get the best in quality and economy in parts, why not send a part print to Ex-Cell-O in Detroit? Write today.
XLO
To learn more about Ex-Cell-O's modern and complete parts production facilities, send for Ex-Cell-O Bulletin No. 36151.
EX-CELL-O
PRODUCTION PARTS
. . . for New and Improved Products
EX-CELL-O CORPORATION
DETROIT 32 MICHIGAN
MANUFACTURERS OF PRECISION MACHINE TOOLS • CUTTING TOOLS • RAILROAD PINS AND BUSHINGS
DRILL JIG BUSHINGS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

Gear errors and Gear noise

should be discovered long before the gears reach final assembly . . .

There is a profit in scrap for the scrap dealer, but most certainly not for the gear manufacturer who suddenly discovers that an entire lot of gears have to be scrapped because they fail to meet tolerance requirements or because they are too noisy.

If economy is important in your plant, the time to find out about machining errors is right at the machine which causes the trouble—not after all the subsequent operations including heat treatment have been completed and the gears assembled in some power unit.

The best insurance against high cost of scrap gears is the use of gear checking machines right down there in the plant where the gears are being produced and where they can be checked periodically by the machine operators.

The Red Ring Gear Checker quickly reveals any dimensional errors and the Red Ring Gear Sound Tester immediately puts an accusing finger on noisy gears. Both machines have laboratory accuracy, they can be used anywhere in the plant or inspection department and they prevent a great deal of waste.

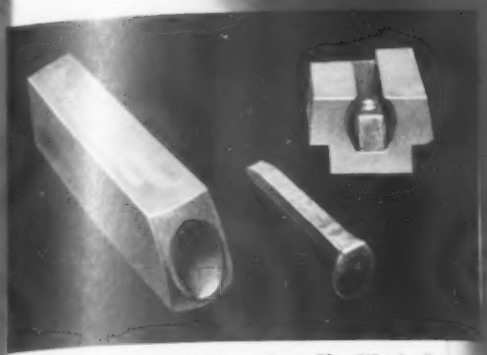
SPUR AND HELICAL
GEAR SPECIALISTS
ORIGINATORS OF ROTARY SHAVING
AND ELLIPTOID TOOTH FORM

Get all the details by writing for Descriptive Bulletins.

NATIONAL BROACH AND MACHINE CO.

5600 ST. JEAN • • • • • • • • • DETROIT 13, MICHIGAN

WORLD'S LARGEST PRODUCER OF GEAR SHAVING EQUIPMENT



Tool costs took a nosedive when Hot-Work 8 was used for the hot-forging of steel spikes up to 5/8-in. square. Spike production now averages 200,000 for dies; 3,100,000 for grippers; and 1,100,000 for pointers. Even longer life is obtained in the production of smaller spikes.

Longer tool life resulted when Hot-Work 8 was used for these header and gripper dies in the semi-automatic manufacture of steel rivets. These dies outproduce other hot-work steels previously used. One set of dies turns out 45,000 rivets of 5/8-in. to 3/4-in. size in 8 hours.

Quick Facts about HOT-WORK 8

TYPICAL ANALYSIS:	C	Cr	Mo	V
	0.60	3.60	8.50	1.75

RED-HARDNESS: High. Excellent resistance to heat-checking and surface wash. Withstands repeated drastic cooling.

WEAR-RESISTANCE: High. For maximum service life in the medium- and high-temperature ranges. Hot-Work 8 gives excellent service life in applications where the tool or die reaches temperatures as high as 1400 F. The material being worked has, of course, much higher temperatures.

SHOCK-RESISTANCE: Good. Stands up under heavy impacts.

HEAT-TREATMENT: Anneal at 1600 F, furnace-cool. Pre-heat to 1600 F prior to hardening. Harden at 2150 to 2200 F, followed by air-quench. Temper at 1120 F for best wear-resistance; at 1200 F for best shock-resistance. Rockwell C-44 to 55.

Write us for your copy of the new booklet, "Bethlehem Hot-Work Tool Steels."

Bethlehem HOT-WORK 8

improves high-temperature TOOL LIFE

Hot-Work 8 is a veteran hot-work tool steel that cuts tool costs because of its high wear-resistance in the higher range of operating temperatures. High resistance to surface wash and heat-checking also account for its long service life on severe hot-work applications. It all adds up to longer life, fewer redressings . . . and lower costs.

Choose Hot-Work 8 when temperatures are high or variable; and when the tool or die is subject to drastic cooling during operation. Hot-Work 8 is versatile because of its excellent balance of properties for such applications as crowners, dollies, hot punches, stamps, striking dies, hot headers, hot shear blades, hot stamps, trimmers, and gripper dies. Full details are available from the nearest Bethlehem sales office or tool-steel distributor.

BETHLEHEM STEEL COMPANY
BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by
Bethlehem Pacific Coast Steel Corporation

Export Distributor:
Bethlehem Steel Export Corporation

BETHLEHEM STEEL

HOT-WORK 8...one of Bethlehem's Fine Tool Steels

Cut YOUR COST PER PIECE WITH SHEFFIELD PRECISIONAIRES

and keep quality competitive

Precisionaires positively measure internal and external dimensions to the accuracy required on the production line, in the toolroom, or in the laboratory.

These trustworthy instruments for reliable dimensional control are universally used for cutting costs and protecting quality. They speed up inspection time and cut the cost of gages.

Scrap is reduced—more good parts are accepted—assembly time is cut—inspection costs go down—quality goes up.

get the "W-HOLE" story

5377

NEW FEATURES

- Linear Column
- Linear Scale
- 80% Reduction in use of air
- Float Positioner
- Wear Compensation Adjustment
- Dual Control of Air Flow
- Dual Filtering of Air
- Wider range of amplifications
- Broader field proven applications

Send this coupon for new 28 page Precisionaire Application Handbook and see how users are cutting costs per piece while maintaining competitive quality.

NAME_____

POSITION OR TITLE_____

COMPANY_____

STREET_____

CITY_____ ZONE____ STATE_____

the *Sheffield* corporation

Dayton 1, Ohio, U.S.A.

GAGES • MEASURING INSTRUMENTS • MACHINE TOOLS • CONTRACT SERVICES • THREADING TOOLS